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NINTH

ANNUAL REPORT

MARCH 31,
1984

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Alberta

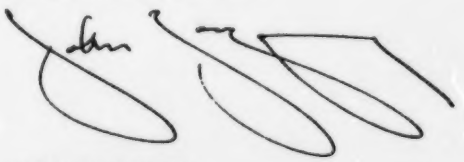
OIL SANDS TECHNOLOGY
AND RESEARCH AUTHORITY

TO HIS HONOUR
FRANK LYNCH-STAUNTON
LIEUTENANT GOVERNOR OF THE PROVINCE OF ALBERTA

Sir,

I have the honour to submit the Annual Report of the ALBERTA OIL SANDS TECHNOLOGY AND RESEARCH AUTHORITY for the fiscal year ended March 31, 1984.

Respectfully submitted,



JOHN ZAOZIRNY
Minister of Energy
and Natural Resources

NINTH

ANNUAL REPORT

MARCH 31, 1984

Alberta

OIL SANDS TECHNOLOGY
AND RESEARCH AUTHORITY

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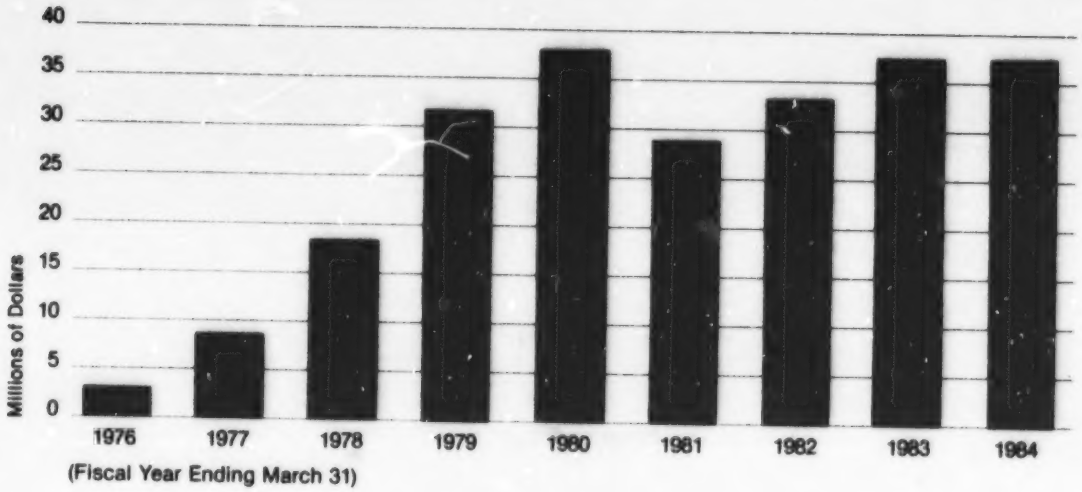
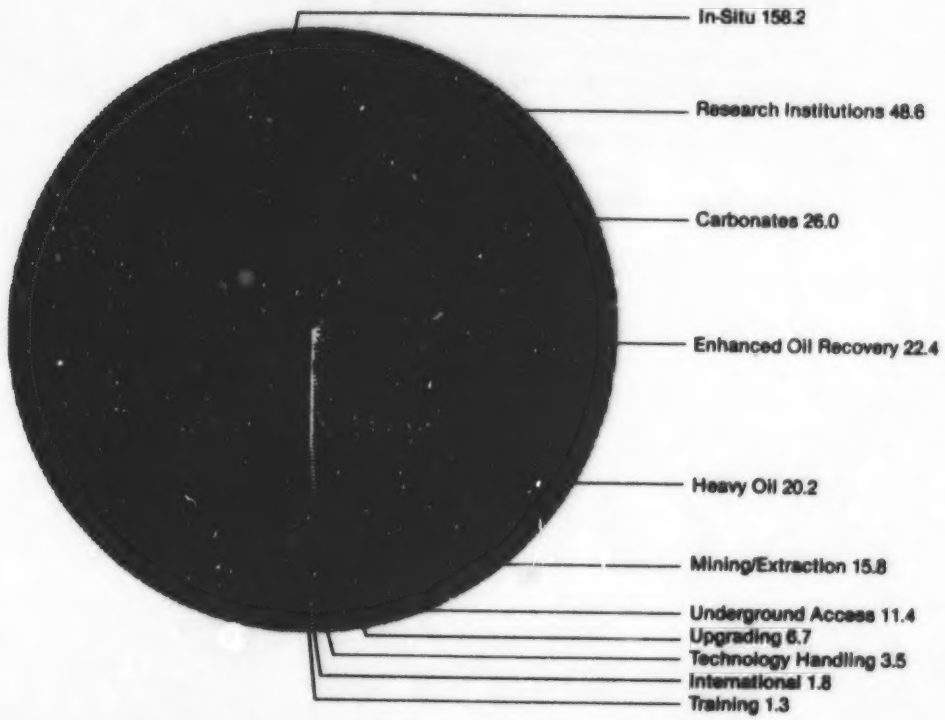
FOREWORD

On January 14, 1974, the Premier of Alberta announced the availability of $100 million to develop new technology for the recovery and processing of petroleum from the Alberta Oil Sands. The terms and conditions for the disbursement of these funds are described in The Oil Sands Technology and Research Authority Act, passed by the Legislature in June 1974 and since amended to include the recovery of heavy oils and the enhanced recovery from conventional petroleum reservoirs. An additional $368 million has been dedicated by the Alberta Government to permit the funding of longer term programs extending beyond 1985.

Annual Investment by AOSTRA in Oil Sands and Heavy Oil Technology (1976-1984)

Figure 1





Commitments from AOSTRA Research Fund To March 31, 1984 ($ Millions)

Figure 2

NINTH ANNUAL REPORT
OF THE
ALBERTA OIL SANDS TECHNOLOGY AND RESEARCH AUTHORITY

To the Honourable John Zaozirny
Minister of Energy and Natural Resources

Sir:

I have the honour to present the Ninth Annual Report of the Alberta Oil Sands Technology and Research Authority (AOSTRA) for the year ended March 31, 1984.

The major AOSTRA field pilots, initiated during the 1976-78 period, are now reaching a mature stage, and it is possible to make the following assessments of the commercial outlook of these pilots:

- The AOSTRA/Shell Canada Resources Ltd./Shell Explorer Ltd. pilot at Peace River has continued to perform well, and Shell has applied to the Energy Resources Conservation Board to expand the pilot to 10,000 BPD. Shell is also undertaking a feasibility study for a further expansion to 40,000 BPD.
- The AOSTRA/BP Exploration Canada Limited pilot project at Cold Lake has completed the steam stimulation phase, and based on encouraging results, BP has received approval from the Energy Resources Conservation Board for the 7,000 BPD commercial Wolf Lake project. Meanwhile, the original pilot is now well into the follow-up combustion phase, designed to increase oil recovery from the reservoir.
- As indicated in previous annual reports, the AOSTRA/Amoco Canada Petroleum Company Ltd. project in the Athabasca deposit (Gregoire Lake site) was unsuccessful in meeting its technical targets, largely due to our inability to establish interwell communication. AOSTRA, Amoco, and Petro-Canada Exploration Inc. have recently begun a new pilot in an attempt to overcome the problems previously experienced.
- The AOSTRA/Union Oil Company of Canada Limited pilot in the bituminous carbonate reservoir, which underlays the Athabasca deposit, has proceeded during the past year with some encouraging results, but still leaving a number of key technical questions to be resolved. A successful pilot would likely lead to a small 5,000 BPD commercial project at an early date.
- The UMATAC Industrial Processes Ltd. dry retorting 5 tonne-per-hour pilot program for extracting oil from mined oil sands, has been successfully completed in Calgary. AOSTRA has designed a 90 tonne-per-hour demonstration plant and if ongoing economic assessments of this process continue to be favorable, and if industry participation is obtained, this demonstration project will be built near Fort McMurray.
- AOSTRA and Vikor Resources Ltd. have initiated an enhanced oil recovery pilot using a CO_2 miscible flood process in an abandoned reservoir near Red Deer. If this pilot is successful, the test program will be expanded throughout the entire field. The process should have application in other partially depleted sandstone reservoirs in the province.

AOSTRA has supported many other important programs, which are described later in this report.

The major weakness in Alberta's current in situ recovery technology remains the difficulty of recovering bitumen from the deeply buried parts of the Athabasca deposit. This deposit has the largest reserves, but is proving to be the most difficult to develop by in situ methods. AOSTRA is supporting four key projects to meet the technical challenge. They are:

Project A — A new pilot with Amoco and Petro-Canada, using steam and additive concepts developed at the Alberta Research Council.

Project B — An underground test facility near Fort McMurray, incorporating shafts, tunnels, and horizontal wells for which industry support is being solicited.

Project C — An electrical preheat development program, building on earlier work of Atlantic Richfield Company and Petro-Canada and its partners.

Project D — Participation in the pilot work of Canterra Energy Ltd. using a combined hot water/steam drive process.

We have learned much from previous Athabasca pilots, and I believe that at least one of the above 4 projects will lead to an acceptable commercial development.

In addition to the critical field pilot tests, the oil sands industry requires technical support in a wide spectrum of areas, including:

- bitumen and heavy oil upgrading
- water treatment
- residue and coke conversion
- equipment testing
- laboratory support
- information and data storage and retrieval

AOSTRA is supporting the industry in all of these areas. It is this comprehensive capability which has resulted in Alberta being recognized as the heavy oil/oil sands technology centre of the world.

One of the most important accomplishments of the AOSTRA-supported programs has been the development of technology capable of being commercialized on a relatively small scale, and used broadly across the province, from Peace River in the northwest to Suffield in the southeast. As a result, Alberta is now in a good position to develop a solid commercial base for its oil sands industry, a base which should grow and sustain the industry for literally hundreds of years. AOSTRA is only one of the participants in this exciting endeavour, but has been a key one, particularly in its role of sustaining the existing projects during the recent recessionary period.

I will personally not be involved in AOSTRA's future activities, but I would like to express my appreciation to the Alberta Government for the opportunity to contribute to, and learn from, a really remarkable initiative in industry/government/university collaboration. The commitment by the Alberta government and industry to AOSTRA and its programs has few, if any, equals in Canada.

Respectfully submitted,

C W Bowman

C.W. Bowman, P.Eng.
Chairman

MEMBERS OF THE AUTHORITY

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Dr. C.W. Bowman

VICE-CHAIRMAN
Mr. M.A. Carrigy

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J.K. Donnelly, P.Eng., BP Exploration Canada Limited
L.G. Hepler, (Chairman), University of Lethbridge
D.B. Livesey, Texaco Canada Resources Ltd.
A. Logan, Gulf Canada Resources Inc.
D.S. Montgomery, University of Alberta

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H.E. Gunning, Alberta Oil Sands Technology and Research Authority
J.B. Hyne, University of Calgary
K.G. McCurdy, University of Lethbridge
F.D. Otto, P.Eng., University of Alberta
E.J. Wiggins, P.Eng., Alberta Oil Sands Technology and Research Authority
S.B. Woods (Chairman), University of Alberta

PATENT COMMITTEE

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T.J. Cyr, (Chairman),
R.W. Luhning, P.Eng.
J.H. Nicholls, P.Eng.
E.K. Spady, LL.B.
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S.E. Green, Technology Librarian
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S.J. Lane, Technical Reviews - University Research
R.W. Luhning, P.Eng., Manager, Thermal Projects
J.H. Nicholls, P.Eng., Director, Technical Programs
D.A. Redford, P.Eng., Manager, Technical Audit
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J.D. Scott, P.Eng., Manager, Enhanced Recovery
H.G. Stephenson, P.Eng., Underground Test Facility
W. Vandenhengel, P.Eng., UMATAC Technical Committee
A.G. Winestock, P.Eng., Manager, Technology Transfer

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H.S. Tymoczko, LL.B.
E.P. Johnson, (Patents & Technology Agreements)
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REPORT OF ACTIVITIES

1. IN SITU OIL SANDS RECOVERY PROGRAM

1.1 AOSTRA – AMOCO Gregoire Lake Pilot Project

The original AOSTRA/Amoco Canada Petroleum Company Ltd. wet combustion pilot (Block I) was located in the south Athabasca oil sands deposit. It was terminated in mid-1981 and the injection and production wells have now all been abandoned. Petro-Canada Exploration Inc. was also a participant in this project.

A review of the results from this pilot has resulted in a joint AOSTRA/Amoco/Petro-Canada technical study group to develop a project for a new pilot, using steam and steam plus additive processes.

An agreement between AOSTRA, Amoco and Petro-Canada was signed early in 1984. The delineation wells for the new pilot have been drilled. It is expected that operation will commence in late 1984. The estimated cost is $22,000,000 and the project will operate for three years.

1.2 AOSTRA – BP Marguerite Lake Pilot Project

The AOSTRA/BP Exploration Canada Limited project, located in the Clearwater sandstone of the Cold Lake oil sands deposit, is designed to test steam stimulation followed by wet combustion. Hudson's Bay Oil and Gas Company Limited and PanCanadian Petroleum Limited are also participants in the project.

The project is now in its fifth year of operation and the initial steam stimulation phase is essentially complete. Concurrent special test wells on air injection confirmed the original plan to follow the steam stimulation phase with air injection to improve ultimate recovery. Feasibility studies led to a decision to use oxygen instead of air for the combustion phase.

Three wells in the main pattern have now been converted to oxygen injection. This phase is planned to continue through 1985.

BP has been joined by Petro-Canada in a 7,000 BPD project designated as Wolf Lake, surrounding the Marguerite Lake project, using project steam stimulation technology. The project is under construction and initial production is expected in early 1985. AOSTRA is not a participant in the Wolf Lake project.

1.3 AOSTRA – BP B-Unit Pilot Project

AOSTRA, BP Exploration Canada Limited and Petro-Canada Inc. are conducting a single well cyclic steam stimulation project (B-Unit Pilot) with two observation wells in the Lower Grand Rapids formation of the Cold Lake oil sands deposits. The object of the B-Unit pilot is to improve bitumen recovery by testing novel fracturing/injection methods which were developed at the AOSTRA-BP Marguerite Lake pilot 10 km to the north. The producing zone is 16 m thick at a depth of 430 m.

The pilot wells were completed, surface facilities constructed, steam stimulation conducted, and the injector/producer was placed on production. The second steam stimulation cycle will be completed by mid-1984 and additional cycles are planned based on the encouraging results from the first two cycles.

During the past year Petro-Canada purchased a 33.33% interest in the project.

The total cost of the project is estimated to be $4.2 million.

1.4 AOSTRA – SHELL Peace River Pilot Project

The AOSTRA-Shell Canada Resources Ltd./Shell Explorer Ltd. Peace River Project, located 30 km northeast of Peace River, is designed as a prototype installation. Amoco Canada Petroleum Company Ltd. is also a participant in this project.

At the pilot site the oil sands are 550 m deep and 27 m thick. The oil sands deposit under the Shell lease fortunately has a bottom interval of high water saturation, averaging 3 m, which has provided an initial path for steam movement at the base of the reservoir.

The test is evaluating pressurization of the reservoir using steam. This process was extensively investigated by physical and mathematical simulation tests prior to the field tests.

Steam stimulation, the first pressurization cycle and the first blowdown of the producing wells have been completed and approximately 16% of the original oil-in-place has been produced. Indications are that additional cycles will result in ultimate recovery of 55% of the original oil-in-place. The second pressurization phase is now proceeding.

A decision has been made to attempt to obtain early production through cyclic steam stimulation and three new wells in a special area adjacent to the main pilot area have been drilled for this purpose. The first cycle will provide information on the use of cyclic steam stimulation as a precursor to the cyclic pressurization recovery process under development in the main pattern area.

The Operator is designing a commercial demonstration project with a capacity of 10,000 BPD. Initial production from the new project is expected in 1985. AOSTRA will not be a direct participant in the commercial project, but the existing facilities will be incorporated into the new project.

1.5 AOSTRA – UNION Buffalo Creek and McLean Pilot Projects

Activity with Union Oil Company of Canada Limited and Canadian Superior Oil Ltd. to develop technology to produce the very large reserves of bitumen in the Devonian carbonate formations continued throughout the year.

This project is located approximately 100 km west of Ft. McMurray, and tests since 1977 have been conducted in the Grosmont 2 formation to examine the suitability of steam stimulation, steam drive and wet combustion processes.

Operations during the 1983-84 period continued through cycles 8 and 9 on the single well steam stimulation test and other special tests for this well are planned for 1984-85.

The first steam stimulation cycle on a new 5-spot pattern (McLean pilot) was completed and production is now underway. The initial results indicated a geological anomaly within the pilot area. In order to maintain the initial pilot concept two additional wells were drilled in early 1984 and operations are continuing.

A cyclic steam test on a well in the original pilot area was initiated in the Grosmont 3 zone. This test is continuing. Future plans will be dependent on the several tests described above.

1.6 AOSTRA – CANTERRA – TENNECO Kearl Lake Pilot Project

This pilot is located 77 km northeast of Fort McMurray, and is operated by Canterra. The pilot is testing a steam drive process in the McMurray sandstone which, in this area, is at a depth of 150 m and is about 43 m thick. The pilot consists of an inverted 7-spot with seven steam injection wells and 6 producers. Operations began in December 1981.

AOSTRA acquired a 12.50% interest in the operating portion of the pilot in March 31, 1983.

The Operator is considering operation of a second pattern. AOSTRA has been invited to join in the expanded operation and is negotiating a new percentage interest in the project.

1.7 AOSTRA – COLD LAKE – BOW VALLEY Pilot

As a result of an application from Cold Lake Heavy Oil Limited to carry out a steam plus additives test in the Cold Lake Clearwater oil sands reservoir, a preliminary laboratory and feasibility study was approved at a cost of $600,000.

This study was completed in March, 1983 and a decision to carry out a field test was made in late 1983. Bow Valley Industries Ltd. joined the project as Operator on the pilot site which is located on a Gulf Canada Resources Inc. oil sands lease. Operations are expected to begin in late 1984 and run for 2 years.

1.8 Data Base Management System

The AOSTRA Data Base System (ADBS) is a computerized data management system designed to store and disseminate operating data from in situ pilots, and is suitable for both thermal and non-thermal projects.

The ADBS storage format provides for extensive reporting in tabular and graphical format of both raw and processed data. Subject to confidentiality clearance, direct access by computer terminals is available to users from both pilot sites and central office locations. The ADBS Command Language component can be used for 'non-routine' access to data to support special engineering studies that occur.

Periodic enhancements are made to the system. During 1983-84, a new reporting package was added to provide customized project reports from practically any combination of data in the data base. Several new graphical formats have recently been included. Additional commands were added to the Command Language to increase the data manipulation capabilities of the system.

The ADBS system software and data reside at the Canada Systems Group Service Bureau (CSG) in Calgary. Field data acquisition systems located at pilot sites can be easily linked to the ADBS to provide a smooth flow of data into individual project data bases.

AOSTRA staff provide full support to users of the system, including the initial setup of a project data base and ongoing operational support as necessary.

During 1983-84, expenditures on the ADBS were $623,000 and revenues were $464,000 or 74% of expenditures. Cumulative expenditures to date are $1,904,000 and cumulative revenues to date are $1,131,000 or 59% of expenditures.

1.9 Computer Modelling

An agreement to give AOSTRA and the Alberta Research Council (ARC) access and use rights to the Computer Modelling Group mathematical models, in return for AOSTRA/ARC experimental data and a payment of $125,000 per year, was concluded in March 1983. Extensive use of the available models was made by AOSTRA in analyzing the performance of several pilots.

1.10 Electric Pre-heat Study

The application of electrical heating technologies to the in situ production of bitumen from the Alberta oil sands, has been actively studied since at least 1973, and AOSTRA has directly supported work in this field since 1977. In addition to in house and contracted studies, AOSTRA, this year, purchased the PCEJ data at a cost of $3.5 million. PCEJ is derived from the names of the participants in the field pilot, located in the Athabasca deposit at Stoney Mountain (40 km south of Fort McMurray): Petro-Canada Inc., Canada-Cities Service Limited, Esso Resources Canada Limited and Japan Canada Oil Sands Limited. AOSTRA has been reviewing and evaluating this data and once this has been completed, a recommendation will be made with respect to further activities.

2. UNDERGROUND ACCESS PROGRAM

Since its inception, AOSTRA has been assessing the possibility of extracting the oil from the oil sands through an array of horizontal wells drilled from tunnels within, or below, the Athabasca deposit.

To gain knowledge of the behavior of oil sands during tunneling, AOSTRA spent $177,390 in 1977 to install instruments in a water diversion tunnel driven through the oil sands outcrops at Saline Creek near Fort McMurray. In 1979, as a result of a call for proposals to evaluate the relative costs of emplacing horizontal wells from the surface and from shafts and tunnels, AOSTRA and Gulf Canada Resources Inc. jointly funded a study to estimate the cost of building a pilot at the Surmont site south of Fort McMurray. Although the report was encouraging, Gulf declined to continue funding the project. In 1982 AOSTRA selected a new site on Crown land in the Athabasca deposit and commissioned Norwest Resource Consultants Ltd. of Calgary to design and estimate the cost of an Underground Test Facility (UTF) which, if built, would provide field experience in shaft sinking and tunneling in oil sands and provide access for the drilling of horizontal wells for an underground thermal in situ recovery pilot.

In late 1983 an application to construct a shaft and tunnel was submitted to the Alberta Energy Resources Conservation Board by AOSTRA and a start was made on the 37 km access road to the site. Infill drilling for geological data was carried out at the site and additional work on the design of an underground drilling system was also started.

To accelerate the construction schedule of the UTF, tenders were called for the construction of two shafts and the initial tunnels, and a presentation to Industry is planned for May, 1984 to enable a construction election in June, 1984.

3. ENHANCED RECOVERY PROGRAM

3.1 AOSTRA – ALBERTA ENERGY Suffield Heavy Oil Pilot Project

This project, located in the Suffield military block in southern Alberta, is operated by Alberta Energy Company Ltd. (AEC) on behalf of AOSTRA and the industry participants which, in addition to AEC, include Dome Petroleum Limited and Westcoast Petroleum Ltd. The pilot is located in a glauconite sandstone and is testing a wet combustion process in a 19.5 m thick heavy oil reservoir underlain by water. The initial test is an inverted 5-spot covering two hectares.

Air injection into the central well commenced in February 1982 and is planned to continue for a further three years. Water injection for the wet combustion phase began in early 1983.

Production to date has been significantly greater than would have been achieved under primary production; water coning, typical of wells in this field, is not yet evident in the pilot wells.

The project is scheduled to run through 1985.

3.2 AOSTRA – VIKOR RESOURCES Joffre Viking CO_2 Miscible Pilot

This pilot, located in the abandoned Joffre Viking pool in central Alberta, is operated by Vikor Resources Ltd. on behalf of AOSTRA and various industry participants. It is located in a lower Cretaceous (Viking) sandstone reservoir and is testing the ability of a CO_2 miscible flood to recover tertiary oil from a 3 m thick, light gravity, oil reservoir which had previously been waterflooded. The initial pilot consists of two 5-spot patterns each covering 160 acres.

Carbon dioxide injection into one of the patterns commenced in January, 1984 and is planned to continue for 3 years. Water injection will be alternated with CO_2 injection (WAG process) for injected fluid mobility control. Production response to CO_2 injection is expected to be evident sometime during 1984.

The gross cost of the project is estimated to be $22 million and it is planned to operate through 1988. If successful, the flood will likely be expanded throughout the entire field, and will have wide application in recovering tertiary oil in other depleted sandstone reservoirs throughout the province.

3.3 AOSTRA – PETRO-CANADA Viking-Kinsella Pilot Project

This project was originally intended to compare combustion and steam flood performance in a thin (4 m) Lloydminster-type heavy oil reservoir. The steam pattern was suspended at the end of 1981 due to a geological anomaly and generally unsatisfactory performance. Drilling of three new production wells within the air pattern in 1982 changed this configuration to two inverted 5- spots on a reduced well spacing. Wet combustion commenced in mid-1983.

A substantial increase in air injection commenced in early 1984 and showed immediate response, and increased oil production is now evident.

The project will continue through 1984 and, if successful, should have application throughout many similar pools in the heavy oil areas of Alberta.

3.4 AOSTRA – HUDSON'S BAY Caustic Flood Test

Tracer tests were conducted on two wells in the Basal Colorado "A" Pool by Hudson's Bay Oil and Gas Company Limited in mid 1980 to evaluate this pool as a candidate for caustic water flooding. The tests determined that the technique was effective for measuring residual oil saturations after a caustic flood. AOSTRA acquired the results of the tests in June, 1981.

An agreement between Hudson's Bay and AOSTRA provides for the possibility of jointly funded additional field work. Hudson's Bay has commenced a field test and negotiations are underway for AOSTRA participation in the test.

3.5 Heavy Oil Lifting Project

In 1979, AOSTRA and nine oil companies entered into an agreement with Pengalta Research and Development Ltd., a Calgary-based firm, to conduct a review of problems involved in lifting or pumping fluids from heavy oil wells.

In Phase II, the original ten participants increased to fourteen and $1.7 million was spent on the establishment of experimental facilities to develop solutions to the problems identified in Phase I.

AOSTRA and ten oil companies have agreed to a new $150,000 Phase IIIA which provides for field testing the most promising pump design developed in Phase II. The field test of this pump is proceeding, and discussions with local manufacturers are proceeding with a view to making the new pump commercially available.

Further development of other innovative pumps designed during Phase II is underway.

3.6 AOSTRA – NORCEN Bodo Field, Laboratory Study

This joint project of AOSTRA and Norcen Energy Resources Limited involved laboratory studies on a comparison of steam flooding versus combustion in the Bodo field. This is a low gravity pool (13.5 API) located in east central Alberta producing from the Mannville "B" sandstone at a depth of approximately 735 m. Norcen's partners in this project include Canadian Reserve Oil & Gas Ltd., Murphy Oil Company Limited and Canada-Cities Service Ltd.

A proposal has been submitted by Norcen with respect to a steamflood field test. If agreement is reached the new test is expected to begin by late 1984.

3.7 AOSTRA – PANCANADIAN Countess "B" Combustion Project

AOSTRA, PanCanadian Petroleum Limited and LL&E Canada Ltd., have agreed to cooperate in a Countess "B" pilot, located 20 km west of Brooks, Alberta. The pilot, consisting of a 40 acre inverted 5-spot pattern and associated surface facilities is designed to evaluate a wet combustion recovery process in the waterflooded Countess Upper Mannville "B" pool. This pool contains medium gravity oil of 28 API at a depth of 1066 m with a pay thickness of 7.6 m.

PanCanadian is operating and financing the field pilot with LL&E. AOSTRA is funding a research program to support the pilot activities with the field, and research results are being shared among the parties. AOSTRA is the owner of, and licensing agent for, the technology being developed, both in the field and in the laboratory.

4. PRODUCED WATER RECYCLING PROGRAM

4.1 Produced Water Treatment Project

The limited supply of fresh water in the heavy oil regions of Alberta, and the large quantity of water co-produced with heavy oil from in situ recovery operations combine to present a unique opportunity for the application of water treatment and recycle technology. The AOSTRA/Industry Produced Water Treatment Study was set up to evaluate and select the most technically suitable and cost effective water treatment systems for upgrading various types of produced water to boiler feedwater qualities.

A detailed evaluation of conventional and unconventional water treatment systems for these waters has been completed. AOSTRA and the participants are now involved in the development of a bench scale program to test the most promising of the processes evaluated. The test program will be designed to verify the assumptions used in the detailed evaluation. The total cost of the preliminary phases of the project has been shared equally among the participants. The current phase is estimated to cost $555,800. Sixty percent of the cost has been assumed by AOSTRA and the remainder is being shared equally among four industry participants. The next phase will be the construction and operation of the bench scale test facility.

4.2 Brackish Water Treatment System

Hankin Environmental Systems Incorporated (formerly Francis Hankin & Co. Limited) have patented a water treatment system to upgrade produced waters from in situ steamflood projects. The purpose of the system is to produce feedwater for utility boilers. A field bench scale test of the Hankin system, which included electrodialysis, ozonation and dissolved air flotation, was carried out in 1983. A final report on the results of the field test is being prepared. AOSTRA support for this program is $432,009.

4.3 Forced Convection Coil Flow Boilers

Forced convection coil flow boilers of limited capacity are commonly used to generate steam for in situ production of bitumen and heavy oils. Centrifugal forces within the tube coils act to maintain a thin layer of water on the tube walls which protects against scale formation. The Waterloo Centre for Process Development is conducting a bench scale test program to study a method by which these centrifugal forces may be reinforced, thereby providing an opportunity for increased steam generation capacity in a single boiler. Funds provided to the Waterloo Centre, in the amount of $262,000, have been expended and AOSTRA is currently exploring with the Waterloo Centre an arrangement under which the work may be completed.

5. SURFACE MINING/EXTRACTION PROGRAM

5.1 UMATAC Dry Retorting Process

AOSTRA and UMATAC Industrial Processes Ltd. have completed a pilot project based on retorting bitumen from oil sands using the Taciuk Processor. The Processor, a rotating vessel, combines retorting of bitumen from oil sand and burning of deposited coke in the same vessel. This Processor may also be suitable for primary upgrading of heavy oils by using sand as a heat carrier.

Construction of a pilot plant in Calgary was completed in the spring of 1978. In excess of 8,000 tonnes of oil sands have been processed in this plant in a successful demonstration of the process concepts.

The second phase of the project, completed in 1982, was designed to investigate specific process parameters, develop design correlations and demonstrate the performance of the process with continuous operation of the pilot plant over extended periods. Two companies, Canstar Oil Sands Ltd. and Gulf Canada Resources Inc., participated in this phase as consultive participants. The total cost of the project to completion was $5.3 million.

In late 1982, AOSTRA and UMATAC entered into the first phase of a program which could lead to a large scale demonstration of the Taciuk Processor. During this phase, the preliminary engineering design, and capital and operating cost estimates for a demonstration facility, are being developed. A technical and economic study of commercial scale projects comparing the Taciuk Processor with a commercial project using Hot Water Extraction and Flexicoking has been initiated with an independent engineering consultant. The existing pilot plant continued to operate, developing additional design and scale-up data for the proposed demonstration facility.

The first phase of the demonstration program is expected to be completed in 1984 followed by a decision whether or not to proceed to construction and operation of a large scale facility. Funding committed for this first phase of the demonstration plant is $4.5 million. Canstar Oil Sands Ltd. continued as a consultive participant throughout the initial phase of the demonstration program.

5.2 INPROTAR MEP-1001 Extraction Process

Inpro Engineering Ltd., has initiated a program to build and test equipment for oil sands extraction. The facility is based on a hot water extraction concept, with the equipment designed to develop a gentle slurrying action to minimize emulsion formation and improve bitumen separation and recovery. AOSTRA funding towards the program is $99,930.

5.3 Basic Research on Direct Oil Sands Retorting

Nova/Husky Research Corporation is conducting a series of experimental tests to determine the effect of water addition, calcium oxide and carbonate addition, and heating rates on hydrocarbon yield and sulphur emissions from direct retorting of oil sands.

AOSTRA and Canstar Oil Sands Ltd. are funding 2/3 and 1/3, respectively, of the $180,000 program.

5.4 Multisolid Fluidized Bed Retort

The Battelle Memorial Institute has developed a multisolid fluidized bed (MSFB) oil sands retorting concept based on their experience with MSFB combustion technology. Battelle has applied to AOSTRA for funding of a small scale test facility to be operated on Athabasca oil sands. Prior to making a decision on the application, AOSTRA has retained an independent consultant to conduct an economic evaluation comparing the Battelle retorting concept with the combination of Hot Water Extraction and fluid coking. The cost of the study is estimated at $43,559.

5.5 PORTA PLANTS INC.

Porta Plants Inc., of Salt Lake City, Utah, has developed a water-based process for extraction of bitumen from oil sands. Preliminary results from tests on Utah and Athabasca oil sands suggested an acceptable bitumen recovery and the ability to recycle a larger fraction of the process water than is possible with the Clark Hot Water Process. AOSTRA provided $10,000 (U.S.) to Porta Plants for a small pilot plant test of the process on low grade (high clay content) Athabasca oil sands. Results from the test have been received and are being evaluated.

5.6 Oleophilic Sieve Extraction Process

Kruyer Research & Development Ltd. of Edmonton has developed a novel method of separating bitumen from mined oil sands by means of an oleophilic sieve. This device captures the bitumen on the coated surface of a perforated continuous belt while allowing water and solids to pass through the openings. The process may provide higher bitumen yields and higher thermal efficiencies than the Clark Hot Water Process. AOSTRA provided $340,000 to Kruyer to construct and operate a small pilot on low grade (high clay content) oil sands. This test has been concluded. A final report on the results of the pilot plant tests has been received.

Negotiations are presently underway among AOSTRA, the inventor of the Kruyer Process and an industrial participant to test the application of the process for the recovery of hydrocarbons from tailings produced by the hot water extraction of bitumen from oil sands.

5.7 Surface Mining/Extraction Program

AOSTRA has funded work by Xana Engineering Ltd. in Calgary, to test the electrophoretic removal of fine solids from tailings sludge generated by hot water extraction of bitumen from oil sands. By recovering the solids for disposal as a consolidated cake, this process has the potential to reduce the size of settling ponds associated with hot water extraction and would increase the amount of clarified water available for recycle.

Based on the results of a laboratory program, a continuous flow pilot plant was constructed and, through an agreement with Syncrude Canada Ltd., tested at Syncrude's plant.

Subsequent to the field test program, further laboratory and bench scale testing was carried out on a modified cell design to provide a realistic basis for a commercial scale design and for the preparation of corresponding capital and operating cost estimates. The results of the cost study indicated there was no economic incentive to continue with the development of the technology as it had been conceived and since corrective measures were not apparent, the project has been discontinued. AOSTRA's total funding of this project was $2.33 million.

5.8 Proposed Oil Sands Demonstration Centre

Testing of new oil sands mining and extraction technologies, on a scale large enough to demonstrate the technical and economic viability of new equipment and processes, is a costly and difficult procedure due to the large quantities of feed required and the need for extensive support facilities.

AOSTRA, in conjunction with eight companies holding mineable oil sands leases, and the Federal Department of Energy, Mines and Resources, investigated the feasibility of constructing an Oil Sands Demonstration Centre in the Fort McMurray area of Alberta. This Centre would be a cooperative, shared cost facility to accommodate large-scale, long-term testing of new technologies that would be applicable to mined oil sands.

Currently, four companies and the Federal Department of Energy, Mines and Resources are participating with AOSTRA in the third phase of the project in which sufficient detailed engineering has been carried out to provide definitive capital and operating cost estimates for the Centre. This design is based primarily on the specific requirements of the first identifiable user of the Centre.

Certain financial incentives for industrial participants in the construction and operation of the Centre have been provided by the Alberta Government.

It is anticipated that a decision by AOSTRA and the participants, whether or not to proceed with construction of the Centre, will be taken later in 1984.

AOSTRA's financial commitment to this project to the completion of the third phase is $455,000.

5.9 LURGI-RUHRGAS Direct Coking Process

In 1976, AOSTRA commissioned an evaluation of the comparative economics of the Lurgi-Ruhrgas direct coking process and the hot water extraction/fluid coking process combination. The study's results prompted the Authority to fund pilot testing of the L-R Process by Lurgi in Essen, West Germany. The test runs were completed in December, 1980, at a cost to AOSTRA of approximately $435,000. The pilot work failed to confirm the performance predictions which had been furnished by Lurgi for use in the 1976 study. In early 1983 AOSTRA commissioned a re-evaluation of the comparative economics based on actual pilot data. The results of this re-evaluation indicate that, with the present configuration of the L-R Process for oil sands applications, no further work by AOSTRA is warranted at this time.

6. UPGRADING RESEARCH PROGRAM

6.1 Heavy Oil and Bitumen Upgrading Study

In September, 1983, a joint AOSTRA/Industry study to evaluate alternatives to current commercial technology for upgrading bitumen and heavy oil was completed by Acres Davy McKee Ltd. at a project cost of $3.5 million. The study was funded, one-half by AOSTRA, with the remaining cost being shared equally among twelve industrial participants.

The major conclusions from this study were as follows:

- There are upgrading processes which offer substantial improvements in liquid product yield and/or economic benefits when compared with commercially applied coking processes but which have not yet been demonstrated on a commercial scale.
- The economic utilization of residue materials from many upgrading projects is yet to be demonstrated.

The ultimate goal of this program is to demonstrate new and improved technologies on a large enough scale to reduce the risk of their commercial application. The results of this study are being used in two further joint AOSTRA/Industry projects, the Upgrading Demonstration Project and the Upgrading Residue Utilization Project.

6.2 *Upgrading Demonstration Project*

A major conclusion of the Heavy Oil Upgrading Study is that the demonstration of improved upgrading processes is required before they can be commercially adopted. As a follow-up to this conclusion, AOSTRA proposed an Upgrading Demonstration Project to the Participants in the Heavy Oil Upgrading Study. The objectives of this project are to select a process or processes from those evaluated in the previous study, to develop a program to demonstrate the selected process or processes and finally to carry out the demonstration program. The intent of this program is to establish the viability of the selected process or processes for commercial oil sands bitumen, or heavy oil upgrading plants, in Alberta.

All of the participants in the Heavy Oil Upgrading Study have agreed to join Phase I of the new project which was initiated in December, 1983. This initial phase will organize and define the project, identify and select project and process options, and develop the business principles for further participation.

Detailed engineering, including preparation of definitive cost estimates and the carrying out of an approved field demonstration program, would take place in the second and third phases, respectively.

6.3 *AOSTRA/Industry Upgrading Residue Utilization Project*

All processes designed for the upgrading of bitumens and heavy oils produce residues which must be utilized in an environmentally acceptable and economically feasible manner.

AOSTRA and ten organizations representing industry and the Federal Government initiated, late in 1982, the first phase of a multi-phase project in which the most promising technologies for utilization of such residues would be identified, evaluated and tested.

Phase I, the "Organizational" Phase, was completed in January, 1984, at a total cost of $90,000. AOSTRA and seven of the ten organizations which participated in the first phase have elected to proceed to Phase II. In the second phase, which commenced in February, 1984, utilization technologies identified in Phase I will be evaluated both technically and economically by an engineering consultant, Monenco Engineers & Constructors Inc. Their work will be completed in mid-1985. The total cost estimated for Phase II is $2,000,000, of which AOSTRA will pay one-half of the cost; the seven other participants sharing the remaining one-half equally.

6.4 *Donor Refined Bitumen*

Gulf Canada Resources Inc. has developed an upgrading process, called the DRB Process, which is based on low pressure, non-catalytic, thermal hydrocracking in the presence of a hydrogen donor solvent. The solvent is a specific distillate cut, derived from the product stream and hydrotreated. The process offers the potential of lower cost, simplicity and improved operability over currently commercial upgrading processes.

AOSTRA agreed to support the 1983 development program by paying $540,000, equivalent to one-half of the 1983 costs. The objectives of this phase of the program have now been achieved.

A test program on the 1 BPD integrated pilot plant has proven the technical feasibility of the process. Donor recycle balance has been demonstrated at conversion levels of 65% to 70%.

The pilot plant also provided data for a technical and economic assessment by Acres Davy McKee Ltd., the same consultant that carried out comparative studies of other upgrading processes in the AOSTRA/Industry Heavy Oil Upgrading Study. The assessment confirmed that the DRB Process is technically sound with a low technological risk and is economically competitive with other hydrogen addition upgrading processes.

6.5 *Fluidized Bed Coke Combustion*

In 1982, the British Columbia Research Council undertook an AOSTRA funded study of the combustion of Syncrude coke in their fluidized bed pilot unit. The objectives of the project were threefold: to determine the effects of limestone addition on SO_2 emissions; to test the leachability of the ash; and to assess the corrosion of common boiler tube alloys in the combustor. AOSTRA committed $100,000 to this project. A final report has been received.

6.6 Dynacracking

AOSTRA was an initial participant in the Calsyn Partnership which proposed to construct a demonstration Dynacracking unit in California. The Dynacracking Process combines cracking and gasification of residual material in a single vessel and offers the potential to upgrade heavy oils to liquid and gaseous products without the production of a residue.

In December, 1983, the Partnership voted not to proceed with the construction phase due to unfavourable project economics. The costs to AOSTRA for participation in the feasibility phase are estimated to total $250,000.

6.7 Upgrading to Petrochemical Raw Materials

Conventional petroleum fractions for making petrochemical starting materials such as ethylene are expected to become scarce and costly. The use of oil sands bitumen as a cracking feed for this purpose offers a plentiful supply of lower cost feed materials and an opportunity for substantial upgrading in value of certain components of the product over transportation uses.

AOSTRA and Mitsubishi Petrochemical Co. Ltd. of Japan have completed testing a direct thermal cracking technique for the production of ethylene and other petrochemical feedstocks from bitumen. The program was carried out by the Alberta Research Council, with technical assistance from Mitsubishi.

AOSTRA has reached agreement in principle, with Mitsubishi, acting on behalf of the Japanese Government and the six companies and two Japanese Government departments who have participated in a 120 tonne per day pilot plant in Japan, to acquire the performance data from the operation of this pilot. This data will be retained by AOSTRA and made available to Alberta companies for future analysis and evaluation of the technology.

7. UNIVERSITY PROGRAM

7.1 Professorships

In the past nine years AOSTRA has appointed eleven professors to chairs at Alberta universities to carry out advanced research on oil sands problems. The term of each initial appointment is 3 years renewable for a further term of 2 years. The incumbent professors may also apply for additional funds for specific research projects.

The current incumbents are involved in the following research projects:

i) Dr. L.G. Hepler of the University of Alberta is continuing his investigation of clay/oil/water systems encountered in many aspects of the oil sands industry and is also measuring specific heats of various components of oil sands and heavy oil deposits.

ii) Dr. E.C. Pielou of the University of Lethbridge is beginning the 2-year renewal of her professorship and will continue investigating the impact of oil sands development on the environment. Studies will be conducted in the areas of reclamation and pollution.

iii) Dr. J.D. Scott is beginning the 2-year renewal of his professorship atthe University of Alberta and will continue the use of analytical modeling techniques and laboratory and field experimental studies to increase basic knowledge of the geotechnical properties of oil sands.

iv) Dr. T.J.T. Spanos is beginning the 2-year renewal of his professorship at the University of Alberta and will continue the mathematical simulation of in situ recovery processes with emphasis on the fundamental equations that describe the dynamics of fluid flow and displacement.

v) Dr. O.P. Strausz of the University of Alberta is continuing the investigation of the chemistry of Alberta oil sands bitumens, with particular emphasis on the heavier fractions.

vi) Dr. E.L. Tollefson of the University of Calgary continues the investigation of desulphurization of coke and the relative fuel values of some constituents of oil sands.

These professors devote approximately three-fourths of their time to oil sands research. The total funds committed to date for the professorship program is $2.9 million.

7.2 Graduate Scholarship and Fellowships

Post-graduate scholarships and fellowships have been made available over an 8-year period for oil sands research at the University of Alberta, the University of Calgary and the University of Lethbridge. Current award holders are identified in the following lists. The scholarships are for a maximum period of 2 years and the research carried out will normally lead to either a Masters or Doctoral degree. Fellowships are intended to assist post-doctoral scientists in furthering their research training. Many of these individuals will eventually enter the industrial research sphere.

University of Alberta	*University of Calgary*	*University of Lethbridge*
Agar, J.G.	Belgrave, J.D.M.	Campbell, J.S.*
Cyr, T.D.*	Calverley, E.A.	
Fiori, M.	Ladd, T.I.*	
Hiebert, A.D.	Lam, H.T.	
Kosar, K.M.	Rao, D.N.*	
[illegible]ni, W.W.		
Law, H.S.*		
McIntyre, D.D.*		
Nonar, A.		
Plewes, H.D.		
Seto, A.C.		
Spence, J.R.		
Treit, J.D.		
Wong, R.C.		

*Fellowship

7.3 University Research Projects

AOSTRA continues to fund various oil sands and heavy oil related research projects in Canadian Universities. The research program covers many areas of interest ranging from fundamental research in the basic science of bitumen and heavy oil to applied research in bitumen recovery and upgrading technologies. The budget in 1983/84 for AOSTRA's support of research in Universities amounted to approximately $3.5 million. More than one hundred researchers (principal researchers, research associates and assistants) in Canadian Universities are currently working under the sponsorship of AOSTRA's University research program. Brief descriptions of the projects carried out in 1983-84 follow:

1) Dr. F.W. Bachelor of the University of Calgary is continuing the program, conducted over the past eight years, of investigations into the nitrogen and oxygen-containing compounds in bitumen. This research has a cumulative funding of $414,503.

2) Dr. M.H.I. Baird of McMaster University is measuring the surface tension of droplets of bitumen in water and developing techniques for characterizing bitumen. A total of $50,374 over 18 months has been awarded to Dr. Baird for this investigation.

3) Dr. D.W. Bennion and Dr. R.G. Moore at the University of Calgary are continuing their extensive investigations of the combustion of oil sands and the low temperature oxidation of bitumen. These researchers have been funded to a total of $1,150,000 over a period of 8 years.

4) Dr. P.M. Boorman and colleagues at the University of Calgary have been investigating the catalytic desulphurization of bitumen since 1976. A total of $500,031 has been awarded to Dr. Boorman for this work.

5) Dr. P.M. Byrne of the University of British Columbia has worked on a method for predicting stress-strain relationships and related stabilities of oil sands, with particular emphasis on conditions appropriate to various excavations. In addition to $30,000 awarded previously, another $28,588 has been made available for continuing support to this project for 16 months.

6) Dr. F.S. Chute and Dr. F.E. Vermeulen of the University of Alberta are measuring electrical properties of oil sands, developing physical models of electrical heating methods, and evaluating the use of electrical power for selective heating of oil sands. Their research has been funded for $369,513 over a seven-year period.

7) Dr. J.W. Costerton at the University of Calgary is investigating the control of bacterial plugging during water or polymer flooding operations. This research has received support of $207,000 over a two-year period.

8) Dr. J.E. Desnoyers of the University of Sherbrooke has been studying phase equilibria and other properties of oil-water microemulsions, with the objective of using microemulsions for extraction of bitumen and heavy oil. These investigations were supported by $275,774 over a period of five years.

9) Dr. S.M. Farouq Ali of the University of Alberta has been investigating the effect of diffusive and gravitational forces on the recovery of heavy oil when using the carbon dioxide slug process. This project has been funded to a total of $421,310 over three years.

10) Dr. D.L. Flock, also of the University of Alberta, is studying the effects of additives in steam on the degree of emulsification of oil in water and the relationships of these effects to overall recovery by cyclic steam stimulation and steam displacement. This is a three-year project costing a total of $300,000. In another project, $56,824 was awarded to Dr. Flock to study the temperature and pressure effects on crude oil recovery from bituminous carbonates.

11) Dr. J.E. Gillott of the University of Calgary is investigating the changes in strength, dimensions, permeability, and bond characteristics of oil well cements after hydrothermal treatment in the presence of formation fluids and drilling muds. This is a two-year project costing $69,689.

12) Dr. E.M. Gates and Dr. R. Toogood of the University of Alberta are investigating the cutting of oil sands by high pressure water jets. Total funding for this research and earlier related research begun by Dr. R. Gilpin is $78,157 over four years.

13) Dr. L.G. Hepler, previously of the University of Lethbridge and now at the University of Alberta, has been doing research on colloidal and thermodynamic properties of various clay, oil and water systems for many years and is also measuring specific heats of minerals and oils from several oil sands and heavy oil deposits. Funding has amounted to $437,524 over eight years.

14) Dr. T.R. Hsu of the University of Manitoba is developing an industrial application oriented computer program to describe the in situ fracturing behavior of oil sand formations subject to optimum combinations of controlled impulse and/or hydraulic loadings. This one-year project will cost $44,760.

15) Dr. I.E. Hutcheon at the University of Calgary is investigating rock-oil-water interactions in heavy oil systems, with particular emphasis on the carbonate deposit. This two-year project will cost $154,020.

16) Dr. J.B. Hyne of the University of Calgary has been studying the reactions of bitumen, emphasizing sulphur-containing compounds, at temperatures and pressures comparable to in situ recovery conditions. Petro-Canada Exploration Inc. and INTEVEP of Venezuela have purchased access to this program by paying 25% and 50%, respectively, of the cost and are participating in technical planning. AOSTRA's contributions to this project have amounted to $1,106,621 over a seven-year period.

17) Dr. F.W. Jones and Dr. J.S. Rogers of the University of Alberta are working on the development and application of an improved tiltmeter. This instrument is potentially useful for following the progress of in situ recovery processes. This three-year project will cost $205,435.

18) Dr. G.A. Karim of the University of Calgary has investigated several problems related to the combustion of bitumen associated with sand grains. This research has been funded for a total of $82,612 since 1976.

19) Dr. N. Kosaric of the University of Western Ontario has been investigating the use of bacteria and bacterial products for breaking emulsions that are formed during production of bitumen and heavy oils, at a cost of $76,147 over 13 months. On January 1, 1984, an additional $51,790 was made available to Dr. Kosaric for further study and evaluation.

20) Dr. H.R. Krouse of the University of Calgary is directing a program designed to provide gas chromatographic/stable isotope analyses for monitoring progress of in situ combustion processes. Total funding has been $350,440 over a six-year period.

21) Dr. R. St J. Lambert at the University of Alberta has been provided with $78,260 for two years to study the tectonic setting and history of the oil sands deposits by a quantified analysis of the subsidence history of the Cretaceous rocks in the Western Canadian Sedimentary basin.

22) Dr. D.G. Lee of the University of Regina conducted exploratory research on the chemical reactions of certain components of bitumen, with a view toward the possible development of new upgrading or analytical methods. This project was supported with $8,000 for eight months.

23) Dr. B.C. Y. Lu of the University of Ottawa is examining the internal consistency of the existing data on gas solubilities in bitumen which are available to AOSTRA. He is also investigating the applicability of various equations of state which could lead to a simpler method for simulating reservoir performance. This one-year project will cost $25,200.

24) Dr. A. Meisen of the University of British Columbia has been examining the possibility of using fluids such as carbon dioxide, ethane and propane, in the supercritical state, for the extraction of bitumen. This one-year project, which will yield fundamental information on equilibrium solubilities as well as extraction rates, will cost $43,000.

25) Dr. N.R. Morgenstern and Dr. J.D. Scott of the University of Alberta have designed and set up a high temperature, high pressure facility and are using the facility to measure strengths, deformabilities, and permeabilities of oil sands at temperatures and pressures encountered in in situ production. This work has been funded to a total of $433,787 over a five-year period.

26) Dr. E.W. Neumann of the University of Toronto has developed a new method for investigating surface thermodynamic properties, such as surface tension of bitumen obtained from different extractions of oil sands of different origins and grades. Funding of this research is $240,479 over four years.

27) Dr. E. Nyland of the University of Alberta is developing and testing a field-oriented microseismic monitoring array for monitoring the progress of oil sand and heavy oil in situ recovery processes. This project will cost $282,300 over a two year period. A further $96,564 was made available to Dr. Nyland and Dr. M.B. Dusseault of the University of Waterloo to refine a prototype observing system for microseismic events related to enhanced recovery projects.

28) Dr. F.D. Otto, Dr. I.G. Dalla Lana and Dr. S.E. Wanke of the University of Alberta are characterizing and evaluating the performance of catalysts for the hydroprocessing of heavy oils from Alberta reservoirs. The two-year project is funded for $252,877.

29) Dr. H. Pascal, at the University of Alberta, is studying the displacement mechanism of heavy oils by water in capillaries. This study was funded for $72,600 for one year.

30) Mr. E. Peake of the Kananaskis Centre for Environmental Research at the University of Calgary is assessing the environmental hazards and human health risks that might arise from toxic and carcinogenic components that could be generated during in situ firefiood production from oil sands. Funding for this project has been $217,000 over two years, with some costs shared equally between AOSTRA and the Alberta Department of Environment.

31) Dr. E.C. Pielou of the University of Lethbridge is investigating possible effects of sulphur dioxide emissions on plant life. Her work involves both field monitoring and controlled-atmosphere greenhouse experiments. Funding is for $102,625 for two years.

32) Dr. R.E. Robertson of the University of Calgary has carried out an extensive range of investigations of emulsions and has been funded for a total of $415,338 for a seven-year period.

33) Dr. R.S. Roche of the University of Calgary is investigating the kinetics of the pyrolysis of bitumen. The chemistry of the thermo-oxidative changes in asphaltenes and other components of bitumen are being studied by non-isothermal programmed pyrolysis-mass spectrometry (NIPPY-MS). This project was funded for $689,923 over seven years. A further $88,724 were awarded to Dr. Roche to continue the research for another year.

34) Dr. D.G. Smith of the University of Calgary has received funds of $37,229 for a year's study of the variations in continuity and thickness of modern analogues of the epsilon mud beds in the McMurray Formation.

35) Dr. T.S. Sorensen of the University of Calgary is evaluating the possibility of catalytic hydrocracking of raw bitumen in a single upgrading step. Transition-metal catalysts supported on γ-alumina are being evaluated and compared under various conditions of temperature and pressure. This project is funded for $252,378 over four years.

36) Dr. T.J.T. Spanos of the University of Alberta is conducting mathematical analyses of fluid-flow behavior in relation to in situ production. This research will cost $128,410 over a three and one-half year period.

37) Dr. P.C. Stangeby of the University of Toronto is investigating the use of a rapid-heating hydropyrolysis procedure for upgrading bitumen. This five-year project will cost $228,316.

38) Dr. O.P. Strausz and Dr. D.S. Montgomery at the University of Alberta have been conducting several continuing research projects involving different aspects of the chemistry of bitumen. One project is a detailed investigation of the asphaltene and resin fractions of bitumen. A second project is to investigate electron paramagnetic resonance as a diagnostic tool for studying polymer and coke formation in Alberta heavy oil. Total funds spent and committed in the period 1977-1985 amount to $2,260,184.

39) Dr. W.Y. Svrcek and Dr. A.K. Mehrotra of the University of Calgary have been measuring the solubilities of gases in bitumen and the viscosities of the resulting gas-bitumen solutions. Total funding has been $490,660 over a period of six years.

40) Dr. E.L. Tollefson of the University of Calgary has been investigating the technology and economics of desulphurizing the coke produced from bitumen upgrading operations. Funding for this research has been $389,666 over a period of four years. In addition, $25,000 has been provided to Dr. Tollefson to conduct exploratory research on the recovery of hydrocarbons from waste tailings of the hot water process.

41) Dr. R.E. Verrall of the University of Saskatchewan is using ultrasonic absorption methods for investigating the dynamics of surfactants in ternary and quaternary microemulsions. This research was supported by $51,390 over a three-year period.

42) Dr. R.C. Von Borstel of the University of Alberta is directing an evaluation of the possible mutagenicity of various process streams from in situ pilot projects and bitumen upgrading operations. This project has been funded at $325,693 over four years.

43) Dr. J.K.S. Wan of Queen's University is investigating the use of microwave induced catalysis in various hydrocracking processes for upgrading bitumen. Total funding is $234,040 for three and one-half years.

44) Dr. N.C. Wardlaw of the University of Calgary is investigating rock-pore properties in carbonate and sandstone reservoirs in relation to enhanced oil recovery. This project is funded with $146,000 over a two-year period.

8. AOSTRA/ALBERTA RESEARCH COUNCIL PROGRAM

AOSTRA continues to support several major programs at the Alberta Research Council (ARC). These programs are described below:

8.1 Oil Sands Laboratory Research

On April 1, 1981, AOSTRA and ARC entered into a five-year agreement to conduct a joint research program at ARC's Oil Sands Research Laboratories at Clover Bar, near Edmonton, with the aim of developing economically viable steam based thermal in situ recovery processes through an integrated and balanced laboratory research plan. In 1983-84, a total of $5 million was expended for the program. AOSTRA contributed 60% ($3.0 million) of the total cost and ARC the remainder.

The major portion of the program includes investigation of the benefits from addition of various additives, such as gases, solvents and surfactants to the injected steam. The investigators are using different sizes of physical simulators and mathematical simulation techniques. In addition, they are determining various physical parameters for numerical modeling, studying physical chemistry of interfacial phenomena and investigating hydrothermal chemistry of fluid-rock interactions. Because of the general interest on the part of industry in developing Cold Lake oil sands, emphasis has temporarily shifted to Cold Lake oil sands for 1983-84. Some notable accomplishments achieved during the year are summarized as follows:

8.1.1 A new experimental Core Evaluation Facility (CEF) was commissioned which enables testing of field cores at Cold Lake reservoir steam flood conditions (7.0 MPa, 280°C). Five, steam-only, tests have been completed which utilized undisturbed reservoir material as well as synthetically prepared cores (simulating the Cold Lake reservoir). Test results from the synthetic cores compare favorably with those obtained using undisturbed field core.

8.1.2 A 2-dimensional test bed has been designed and constructed for simulating fracture flow conditions during a steam flood in the Cold Lake reservoir. Extensive numerical modeling efforts were employed to assist in designing the test bed and the experimental test conditions. The effect of test bed size, orientation, heat loss through various insulation materials and operating strategies were assessed during the studies.

8.1.3 The three component steam additive numerical model was completed and successfully used to simulate the results from a steam-CO_2 experiment in the 150 cm physical simulator. Also, silica mass transport during steam injection in the 150 cm physical simulator was satisfactorily predicted by using the three component model incorporating silica dissolution, transport and precipitation kinetics data obtained from fluid-rock hydrothermal chemistry studies.

8.1.4 X-ray xeroradiographic systems were successfully used to observe the interior of cores during oil displacement experiments. Pictures of both "piston type" and "fingering type" displacement were obtained. Pictures, taken during hot water floods with surfactant additives, give insight into the mechanisms by which the surfactants improve the oil recovery.

8.1.5 Displacement experiments using Cold Lake field cores showed again that surfactant additives to steam injection processes can substantially increase bitumen recovery.

8.1.6 The foam-bubble coalescence method was developed to determine the force between two bubbles separated by a thin liquid film. This method was used to evaluate the relative stability of foams for use in improving conformance.

8.1.7 A theoretical study was carried out using the Site Dissociation Model to predict the surface potential at the silica/water and clay/water interface over wide ranges of pH and brine concentrations.

8.1.8 Surfactants naturally present in the bitumen were shown to be decomposed at elevated temperatures.

8.2 Sample Bank

During the final year of the three-year contract, AOSTRA provided the Sample Bank with $275,324 to continue their services which include collection, storage, distribution, analysis and evaluation of various oil sands and bitumen samples. In 1983-84, the Sample Bank shipped 137.5 tonnes of oil sands (142 individual samples) to many petroleum research laboratories around the world. The tonnage of oil sands samples shipped increased by 32% compared to the previous year, although the total number of samples decreased by 16%.

8.3 Geology

Early in 1980, and supplemented early in 1984, AOSTRA agreed to provide a total of $2,115,000 to ARC to conduct regional geological studies in oils sands, carbonate and heavy oil areas. The contract provides for work continuing over a four-year period.

Regional studies are continuing in the Athabasca, Cold Lake, Carbonate and Mississipian bitumen reservoirs. A geologist has also been assigned as a member on the technical committees on each AOSTRA field pilot.

Several site specific studies were completed, including a review of two existing pilots and a review of two new proposals. Special studies with respect to new projects have also been completed during the course of the agreement.

A further agreement to complete the regional studies at a cost of $1,333,000 is in preparation.

8.4 Oil Sands Information Centre

During the fourth year of a five-year agreement, AOSTRA provided $491,801 to ARC to continue the operation of the Alberta Oil Sands Information Centre (AOSIC). AOSIC collects and disseminates information related to oil sands, heavy oil and enhanced oil recovery.

In addition to publishing quarterly the Alberta Oil Sands Index (AOSI) and the Heavy Oil/Enhanced Recovery Index (HERI), AOSIC provides on-line access to both computerized AOSI and HERI data bases. AOSIC also publishes and distributes the "Tar Paper" to interested people in the oil sands and heavy oil fields.

9. PROGRAMS AT OTHER RESEARCH INSTITUTES

9.1 Petroleum Recovery Institute Program

In the 1981-82 fiscal year, AOSTRA made provision for the expenditure of $300,000 by the Petroleum Recovery Institute in Calgary for engineering studies of enhanced oil recovery (EOR) possibilities in Alberta. EOR processes are sensitive to reservoir conditions and to rock and fluid parameters. The research program was directed towards identifying suitable locations for tests of particular EOR processes.

One of these projects resulted in a CO_2 stimulation field test by AOSTRA and Husky Oil Ltd.

A combined engineering/geological study of EOR methods in the Pembina Cardium pool was approved for funding by AOSTRA and will be completed in the first quarter of 1984. The cost of this project is estimated at $330,000. It is expected that this study will lead to a field pilot in the Pembina field.

In addition to providing support for specific projects, AOSTRA is matching the industry grants for the service facilities of PRI, which previously had been done by the Department of Energy and Natural Resources.

9.2 British Columbia Cancer Foundation Program

AOSTRA provided the Carcinogen Testing Laboratory of the British Columbia Cancer Foundation with $125,000 over a two-year period to evaluate the use of mammalian cells in genotoxicity testing of oil sands process streams and related materials. In total, 25 samples were collected from various AOSTRA-supported pilot projects. These samples are being assayed for the capacity to induce chromosome and DNA damage in Chinese hamster ovary cells and human skin fibroblasts, respectively. The entire study is aimed at developing a relevant system for making human carcinogenic risk assessments.

9.3 D.B. Robinson & Associates Ltd.

AOSTRA provided $64,420 to D.B. Robinson and Associates Ltd. of Edmonton to collect and compile, into a data book, the published and a substantial amount of unpublished information on the thermodynamic and transport properties of bitumens and heavy oils. Specifically these properties include the following: density, viscosity, gas solubility, phase equilibrium ratios, molecular weight, surface and interfacial tension, diffusivity, heat capacity, thermal conductivity and heat of combustion. AOSTRA is planning to publish the book when it is completed in 1984.

9.4 Syncrude Canada Ltd.

AOSTRA and Syncrude Canada Ltd. have agreed to jointly fund a research project to develop a computerized regional Air Quality Prediction System (AQPS) which will forecast, up to eight hours in advance of real time, the possibility of air pollution exceeding the Provincial air quality standard in the Ft. McMurray area, so that mitigating actions can be taken.

Syncrude is the operator of the project which is anticipated to be completed by June, 1986. The total cost will be $2,392,200 with AOSTRA to pay one-third of the project cost ($797,400).

9.5 Hycal Energy Research Laboratories Ltd.

AOSTRA is participating in a cooperative industry supported laboratory research program to investigate the effects of CO_2 in displacing heavy oil and bitumen. The program is being conducted by Hycal Energy Research Laboratories Ltd. in Calgary at a cost of $230,000 over two years. AOSTRA's share is $11,500, and there are 13 industry participants presently in the study.

9.6 Hatch Associates Limited

AOSTRA has committed $383,950 to Hatch Associates Limited to carry out two-dimensional scaled model laboratory studies for demonstrating gravity drainage from a modeled in situ bitumen or heavy oil element using carbon dioxide or ethane for viscosity reduction of the oil, and to derive a mathematical model of describing gravity drainage enhanced by dissolution of carbon dioxide or ethane into bitumen.

10. INVENTORS GRANT ASSISTANCE PROGRAM

During the past fiscal year AOSTRA implemented the Inventors Grant Assistance Program (IGAP) to encourage and assist inventors in developing inventions beyond the idea and concept stage for the purpose of obtaining conventional funding for commercialization. Amounts to a maximum of $50,000 may be awarded to individuals or companies for use in developing inventions. AOSTRA does not earn any use rights to the inventions and the only requirement on the part of the inventor is a commitment to expend the funds in the development of the invention, and to supply both accounting and technical reports to AOSTRA.

This has been a very popular program with a total of 41 applications being received during the first 9 months of the program's existence. Six of these applications were approved for funding and a total of $313,821 has been granted to the inventors.

IGAP Recipient	*Amount of Grant*	*Activity Supported*
A. Palynchuk	$50,000.00	Build and test a prototype hydraulic pump jack with control capability
J. Kruyer	$15,000.00	Patent protection for an Oleophilic Sieve Process for Bitumen extraction
Pengalta Research and Development Ltd.	$25,000.00	Performance tests of a prototype hydraulic blow out preventor and stuffing box
CETEC Engineering Co. Ltd.	$50,000.00	Build and test a device to apply an intense vibrating action to slurries of oil sand to improve the hot water extraction process
B.A. Moore	$50,000.00	Development of a prototype reactor for a Wet Air Combustion Process to produce low cost steam from produced water
B.G. MacKinnon	$41,141.00	Build and test a solid state electronic control unit for optimizing oil well pumping operations

11. INTERNATIONAL PROGRAM

International activities continue to be an area of major interest to AOSTRA, but the depressed international economic climate has reduced short term prospects for significant sales of AOSTRA technology. Co-operative efforts are continuing, however, and there has been strong promotion of Alberta goods and services.

AOSTRA personnel during the year visited Peru, People's Republic of China, Madagascar and the United States to pursue technical interests. The delegation to Peru spent a week consulting with Petro-Peru technical staff with the objective of becoming familiar with their operations and determining how AOSTRA could become involved. (A short term consulting assignment for an ARC geologist resulted from this visit.) A two person delegation from AOSTRA travelled to the People's Republic of China to further evaluate their technology and the prospects for exchanges. An AOSTRA engineer travelled to Madagascar to provide guidance for obtaining a large sample (550 tonnes) of their oil sands for shipment to Alberta for testing in the Taciuk Processor. AOSTRA personnel visited the TRW organization in California to be up-dated on progress being made in the experimental work being done for the United States Department of Energy under the joint Canada/U.S. M.O.U. project. Each country is to spend $600,000 screening steam additives to indicate those which are most prospective in terms of enhancing heavy oil recovery. The Canadian program will be defined after the best additives have been identified in the United States.

12. TRAINING PROGRAM

Due to the downturn in economic activity since 1982, and the change in commercial emphasis for oil sands projects from a few mega-projects (120,000 B/D) to many small scale (10-30,000 B/D) in situ plants, a change in the training programs was needed and no formal training sessions were conducted by AOSTRA in 1983/84. Instead, AOSTRA has concentrated on hiring more students during the summer recess and employing new graduates in temporary jobs. The Master of Oil Sands Engineering program has also been suspended pending a re-evaluation of its usefulness.

13. METHODS FOR ACQUIRING AOSTRA TECHNOLOGY

All technology developed from projects funded by AOSTRA is available under fair business terms.

13.1 Completed Projects

For those projects which are completed, a potential purchaser of information or use rights may negotiate with AOSTRA to arrive at a suitable acquisition price. This price is dependent upon the usefulness of the technology rather than the cost of developing it.

13.2 Active Projects

Technology may also be accessed on an ongoing basis from a currently operating project by joining the project as an active participant. The minimum basis of participation is a 12 1/2% interest with the participant having voting rights and a world-wide license fee-free right to use the technology. An alternative approach is through the consultive participant role in which the participant pays less than 12 1/2% of the cost and does not have voting privileges but does, however, acquire technology use rights.

13.2.1 University Research Projects

Over the past year, a total of 10 companies have been accessing the results from the University projects. These industry participants jointly pay more than 24% of the cost of the University activity. Under this access program the companies earn use rights and have the privilege of visiting the various laboratories and consulting with the researchers.

13.2.2 Joint AOSTRA/ARC Laboratory Program

There are currently four companies participating in this Access program. This program provides for the use of the technology without fee and for meaningful input into the direction and content of the research work.

The companies have taken advantage of the opportunities and have been providing useful advice to those conducting the experimental work.

13.2.3 The Data Base Management System

As outlined in Section 1.8, the ADBS provides full data storage, access and reporting for in situ pilot projects. Five companies operating six projects are currently using the system. Licensing arrangements are made between AOSTRA and individual companies with system charges being directly related to the volume of data and amount of use. AOSTRA will arrange for a "live demonstration" of system capabilities for interested companies.

14. PATENTS

14.1 AOSTRA Patents

The following patents and patent applications are assigned to AOSTRA:

(a) Canadian Patents

Canadian Patent No.	Date Issued	Patent Title
1,120,418	Mar. 23/82	Process and Apparatus for Thermally Processing Heavy Hydrocarbon Containing Liquids (W. Taciuk)
1,121,749	April 3/82	Apparatus and Process for Recovery of Hydrocarbons from Inorganic Host Materials (W. Taciuk)
1,102,234	June 2/81	Gaseous and Solvent Additives for Steam Injection for Thermal Recovery of Bitumen from Tar Sands (D.A. Redford and M.R. Hanna)
1,122,015	April 20/82	Process for Microbiologically Leaching Coke (T.R. Jack et al)
1,129,801	Aug. 17/82	Alkali Recycle Process for Recovery of Heavy Oils and Bitumens (M.A. Kessick)
1,134,174	Oct. 26/82	Two-Phase Wet Steam Flowmeter (D.S. Scott and E. Rhodes)
1,158,458	Dec. 13/83	Variable Drive for Pump Jack (D.L. Buckler)

(b) Canadian Patent Applications

Canadian Patent Application No.	Date Filed	Patent Application Title
378,386-3	May 26/81	Electrophoretic Process for Separating Aqueous Mineral Suspensions (R.A. Ritter)
379,072	Feb. 22/83	Improved Process for Recovery of Residual Bitumen from Tailings from Oil Sand Extraction Plants (E.L. Tollefson and E.S. Hall)
401,758	April 27/82 (Amended Feb. 24/84	Use of Surfactants to Improve Oil Recovery During Steam Flooding (E.E. Isaacs and D.R. Prowse)
406,304	June 29/82	Use of Hydrogen-Free Carbon Monoxide with Steam in Recovery of Heavy Oil at Low Temperatures (J.B. Hyne/J.D. Tyrer)
434,617	Aug. 15/83	Additive for Inclusion in a Heavy Oil Reservoir Undergoing Steam Injection (J.B. Hyne and P.D. Clarke)
445,367	Jan. 16/84	Catalytic Sulphur Removal from Hydrocarbons (P.M. Boorman et al)

(c) U.S. Patents

U.S. Patent No.	Date Issued	Patent Title
4,180,455	Dec. 25/79	Process for Thermal Cracking a Heavy Hydrocarbon (W. Taciuk)
4,280,879	July 28/81	Apparatus and Process for Recovery of Hydrocarbons from Inorganic Host Materials (W. Taciuk)
4,306,961	Dec. 22/81	Process for Recovery of Hydrocarbons from Inorganic Host Materials (W. Taciuk Tarsand Version)
4,285,773	Aug. 25/81	Apparatus and Process for Recovery of Hydrocarbons from Inorganic Host Materials (Taciuk Lloyminster Version)
4,312,234	Jan. 26/82	Two-Phase Wet Steam Flow Meter (D.S. Scott and E. Rhodes)

4,271,905	June 9/81	Gaseous and Solvent Additives for Steam Injection for Thermal Recovery of Bitumen from Tar Sands (D.A. Redford and M.R. Hanna)
4,406,499	Sept. 27/83	Method of In Situ Bitumen Recovery by Percolation (M.A. Kessick)
4,438,218	Mar. 20/84	Catalytic Sulphur Removal from Hydrocarbons (P.M. Boorman et al)

(d) U.S. Patent Applications

U.S. Patent Application No.	Date Filed	Patent Application Title
06/330,162 (476,820)	Dec. 14/81 (Amended Mar. 24/83)	Electrophoretic Process for Separating Aqueous Mineral Suspensions (R.A. Ritter)
06/294,523	Aug. 20/81	Variable Speed Pump Jack (D.L. Buckler)
373,164	April 29/82	Use of Surfactants to Improve Oil Recovery During Steam Flooding (E.E. Isaacs and D.R. Prowse)
394,685	July 2/82	Use of Hydrogen-Free Carbon Monoxide with Steam in Recovery of Heavy Oil at Low Temperatures (J.B. Hyne/J.D. Tyrer)
447,948	Mar. 23/83	Process for Upgrading a Heavy Viscous Hydrocarbon (I. Lutz) (Acres Davy MacKee DM International, Inc., Houston)
525,349	Aug. 19/83	Additive for Inclusion in a Heavy Oil Reservoir Undergoing Steam Injection (J.B. Hyne and P.D. Clarke)

(e) Venezuela Patent Applications

0067	Jan. 21/81	Gaseous and Solvent Additives for Steam Injection for Thermal Recovery of Bitumen from Tar Sands (D.A. Redford and M.R. Hanna)
1933	Oct. 31/79	Process and Apparatus for Thermally Processing Heavy Hydrocarbon-Containing Liquids (W. Taciuk)

264	Feb. 25/80	Apparatus and Process for Recovery of Hydrocarbons from Inorganic Host Materials (W. Taciuk)
991/80	June 10/80	Process for Microbiologically Leaching Coke (J. Zajic/Sullivan)
785/81	May 9/81	Two-Phase Wet Steam Flowmeter (D.S. Scott and E. Rhodes)
108/82	Jan. 22/82	Wet Combustion Process (D.W. Bennion, R.G. Moore and K. Donnelly)
1299/82	July 21/82	Use of Hydrogen-Free Carbon Monoxide with Steam in Recovery of Heavy Oil at Low Temperatures (J.B. Hyne/J.D. Tyrer)
1803/83	Nov. 11/83	Additive for Inclusion in a Heavy Oil Reservoir Undergoing Steam Injection (J.B. Hyne and P.D. Clarke)

(f) Mexico Patent Applications

179,758	Oct. 24/79	Process and Apparatus for Thermally Processing Heavy Hydrocarbon-Containing Liquids (W. Taciuk)

(g) European (EEC) Patents

0-028-666 (Belgium, France, Italy, Netherlands and U.K.) 79,302542.0 (Sweden) 29-65-154.5 (Germany)	April 6/83	Process and Apparatus for Thermally Processing Heavy Hydrocarbon-Containing Liquids (W. Taciuk)
81.304752.9	Oct. 13/81	Two-Phase Wet Steam Flowmeter (D.S. Scott and E. Rhodes)

(h) Argentina Patent Applications

279,427	Dec. 21/79	Process and Apparatus for Thermally Processing Heavy Hydrocarbon-Containing Liquids (W. Taciuk)

(i) Romania Patent Applications

99095	Oct. 30/79	Process and Apparatus for Thermally Processing Heavy Hydrocarbon-Containing Liquids (W. Taciuk)

(j) Turkey Patent Applications

14426	Dec. 21/79	Process and Apparatus for Thermally Processing Heavy Hydrocarbon-Containing Liquids (W. Taciuk)

(k) Japan Patent Applications

138227/79	Oct. 25/79	Process and Apparatus for Thermally Processing Heavy Hydrocarbon-Containing Liquids (W. Taciuk)
172665/81	Oct. 28/81	Two-Phase Wet Steam Flowmeter (D.S. Scott and E. Rhodes)

14.2 Prior Company Patents

(for which AOSTRA has acquired certain Licensing Rights)

(a) Canadian Patents

	Canadian Patent No.	Date Issued	Date Filed	Related U.S. Patent No.	Patent Titles
1.	787182	6-11-68	10-18-63	3244229	Production of Fluids From Unconsolidated Formations
2.	794324	10-10-68	5-04-65	-	Separation Process
3.	794670	10-17-68	10-27-65	-	Method of Producing Hydrocarbons
4.	803818	1-14-69	5-13-66	3244229	Production of Fluids From Unconsolidated Formations

5.	806945	2-25-69	12-06-65	-	Well Pump
6.	815802	6-24-69	11-22-66	-	Valve for Obtaining a Sample of the Fluid Flowing in a Pipeline
7.	820083	8-12-69	2-20-67	3366177	Production of Petroleum from Unconsolidated Formations
8.	839042	4-14-70	3-18-66	-	Method of Producing Hydrocarbons from a Subsurface Formation by Thermal Treatment
9.	840211	3-28-70	1-17-66	-	Method of Recovering Hydrocarbons from an Underground Hydrocarbon Containing Formation
10.	840789	5-05-70	1-17-66	-	Method of Producing Hydrocarbons from an Underground Formation
11.	856023	11-17-70	2-23-68	-	Consolidating Earth Formations
12.	858309	12-15-70	23-68	-	Thermal Secondary Recovery
13.	890741	1-18-72	2-21-69	-	Method of Recovering Hydrocarbons from an Underground Hydrocarbon Containing Formation
14.	941735	2-12-74	6-01-71	-	Oil Recovery Using Steam and Chemical Drive Fluids
15.	1125649	15-06-82	19-12-79	4234042	Direct Combustion Stimulation of a Producing Well
16.	1118341	16-02-82	14-09-79	4272487	Indirect Thermal Stimulation of Producing Wells

(b) U.S. Patents

	U.S. Patent No.	Date Issued	Date Filed	Related Canadian Patent No.	Patent Titles
1.	3332480	7-25-67	3-04-65	776487	Recovery of Hydrocarbons by Thermal Methods
2.	3372750	3-12-68	11-19-65	827466	Recovery of Heavy Oils by Steam Injection
3.	3375870	4-02-68	11-19-65	827467	Recovery of Petroleum by Thermal Methods
4.	3384172	5-21-68	11-19-65	-	Producing Petroleum by Forward Combustion and Cyclic Steam Injection
5.	3399722	9-03-68	5-24-67	847137	Recovery of Petroleum by a Cyclic Thermal Method
6.	3434544	3-25-69	12-22-66	-	Method for Conducting Cyclic Steam Injection to Recover Hydrocarbons
7.	3459265	8-05-69	7-28-67	849320	Method for Recovering Viscous Oil by Steam Drive

8.	3460621	8-12-69	5-22-67	848245	Cyclic Steam Injection and Gas Drive
9.	3464491	9-02-69	12-18-67	848244	Oil Recovery from Formations Containing Channels
10.	3481399	12-02-69	6-10-68	866576	Recovery of Oil by Flashing of Heated Connate Water
11.	3504745	4-07-70	5-08-68	853995	Use of Foams to Prevent Vertical Flow in Tar Sands During In Situ Combustion
12.	3547195	12-15-70	6-19-69	881914	Pyrolitic Plugging of Oil Bearing Formations by Underground Combustion
13.	3430700	3-04-69	10-16-66	852555	Recovery of Petroleum by Thermal Methods Involving Transfer of Heat from one Section of an Oil Bearing Formation to Another
14.	3729337	4-24-73	4-20-70	-	Production of Petroleum from Unconsolidated Formations
15.	3964547	6-22-76	10-29-74	972679	Use of Tar as a Diverter in Steaming Operations
16.	4147213	4-03-79	-	-	Combustion Air Injection Well
17.	4234042	18-11-80	11-06-79	1125649	Direct Combustion Stimulation of a Producing Well
18.	4272487	-	1-01-79	1118341	Indirect Thermal Stimulation of Producing Wells

TABLES

TABLE 1

Summary of Funds Committed and Disbursed to March 31, 1984

Project	Funds Committed	Prior Years' Disbursements	Disbursements April 1/83 to March 31/84	Balance
Institutional Research				
Alberta Research Council				
– Information Centre	$ 3,100,000	$ 2,145,396	$ 495,183	$ 459,421
– Oil Sands Research Centre	17,893,027	14,109,093	3,236,077	547,857
– Sample Bank	1,002,868	868,044	134,761	63
– Geological Program	2,115,009	1,412,730	642,157	60,122
Inventors Assistance Grant	200,000	–	130,000	70,000
University Contracts	15,596,177	11,095,201	3,152,248	1,348,728
Professorships	2,866,342	1,902,248	461,515	502,579
Post Doctoral Fellowships	100,000	–	1,040	98,960
Scholarships and Fellowships	2,180,000	887,221	383,807	908,972
Hatch and Associates	383,950	–	246,258	137,692
Ontario Research Foundation	10,700	6,099	–	4,601
British Columbia Cancer Foundation	125,000	43,126	63,514	18,360
ARC – Access Program	25,000	–	4,244	20,756
University Access Program	150,000	97,812	35,918	16,270
Program Planning and Evaluation	1,584,000	–	192,924	1,391,076
Petroleum Recovery Institute	516,000	–	514,315	1,685
Syncrude Canada Ltd.	797,400	–	581,730	215,670
	$ 48,645,473	$ 32,566,970	$ 10,275,691	$ 5,802,812
Mining and Extraction				
Retorting				
– Umatac	$ 10,550,000	$ 5,978,678	$ 2,800,255	$ 1,771,067
– Lurgi	721,820	506,441	38,579	176,800
Tailings Treatment				
– Xana	2,457,879	2,052,161	332,585	73,133
– EcoPlastics	63,318	59,917	–	3,401
Dredging	202,658	202,502	(43)	199
Solvent Study	26,343	26,343	–	–
Oil Sands Demonstration Centre	1,025,000	8,216	218,782	798,002
Kruyer Research	340,000	340,000	–	–
Suncor/Kruyer Project	60,000	–	60,000	–
R.T.R. Project	100,000	100,000	–	–
Nova/Husky/Canstar	120,000	–	65,889	54,111
Inpro Engineering	99,930	–	5,338	94,592
	$ 15,766,948	$ 9,274,258	$ 3,521,385	$ 2,971,305
In Situ Oil Sands				
Peace River				
– Shell	$ 74,839,351	$ 60,167,076	$ 3,037,950	$ 11,634,325
Athabasca				
– Amoco	44,055,358	24,806,130	(66,986)	19,316,214
– Numac/Gulf	1,650,661	1,449,750	(285)	201,196
– Hudson's Bay	100,000	36,843	–	63,157
– Canterra Energy Ltd.	7,050,000	6,190,000	46,384	813,616
– Petro-Canada/Esso	3,500,000	–	3,500,000	–
– Texaco Canada	30,000	–	41,570	(11,570)
Wabasca				
– General American	1,500,000	1,284,680	37,211	178,109
Cold Lake				
– B.P.	23,527,750	14,957,115	878,117	7,692,518
– Colt Engineering	39,500	–	40,330	(830)
– Suncor – Ft. Kent	50,000	–	14,641	35,359
	$156,342,620	$108,891,594	$ 7,528,932	$ 39,922,094

TABLE 1 CONT'D.

Project	Funds Committed	Prior Years' Disbursements	Disbursements April 1/83 to March 31/84	Balance
In Situ Oil Sands Fwd.	$156,342,620	$108,891,594	$ 7,528,932	$ 39,922,094
Gemini	264,211	260,370	–	3,841
Walden	96,500	96,614	–	(114)
Francis Hankin	457,009	25,695	379,905	51,409
Monenco	38,000	38,000	–	–
Mineralogical Study	6,250	–	1,001	5,249
Waterloo Centre	424,694	229,647	189,046	6,001
Electrical Heating Study	151,000	37,443	96,323	17,234
Water Treatment Study	408,480	(1,146)	133,767	275,859
Consultants	36,430	30,600	–	5,830
	$158,225,194	$109,608,817	$ 8,328,974	$ 40,287,403
Underground Access				
Athabasca				
– Tunnelling	$ 177,390	$ 177,390	$ –	$ –
– Gulf Surmont Project	4,960,143	4,909,682	21,192	29,269
– U.T.F. Project	6,281,947	1,289,690	3,376,745	1,615,512
	$ 11,419,480	$ 6,376,762	$ 3,397,937	$ 1,644,781
Carbonate Trend				
Buffalo Creek				
– Union Oil	$ 25,985,000	$ 18,603,118	$ 2,950,100	$ 4,431,782
Heavy Oil				
Petro-Canada	$ 13,958,046	$ 10,909,842	$ 993,554	$ 2,054,650
A.E.C.	6,051,500	4,735,186	224,545	1,091,769
Pengalta	238,200	157,270	25,934	54,996
	$ 20,247,746	$ 15,802,298	$ 1,244,033	$ 3,201,415
Enhanced Recovery Conventional Oil				
Vikor Resources Ltd.	$ 18,875,000	$ –	$ 4,666,445	$ 14,208,555
P.R.I.	1,055,000	273,667	553,804	227,529
PanCanadian Petroleum	1,500,000	–	116,017	1,383,983
McCallum, Stewart & Associates	27,000	26,673	–	327
Husky Oil	200,000	121,938	33,445	44,617
Norcen	125,000	85,289	3,513	36,198
Cold Lake Heavy Oil	600,000	240,260	111,290	248,450
D.B. Robinson	17,125	–	17,325	(200)
Hycal Energy	11,500	–	8,625	2,875
	$ 22,410,625	$ 747,827	$ 5,510,464	$ 16,152,334
Bitumen Upgrading				
Flexicoking – Exxon	$ 500,000	$ 353,829	$ –	$ 146,171
Hydrocracking – E.M.R.	214,520	214,520	–	–
Hydrotreating – UOP	176,183	176,183	–	–
– Catalytic Inc.	206,640	201,172	–	5,468
Residue Utilization Project	1,090,000	10,645	23,730	1,055,625
Heavy Oil Upgrading Demo Centre	85,000	–	13,061	71,939
Heavy Oil Upgrading Study	1,810,000	1,653,939	202,520	(46,459)
Fluid Bed Combustion				
– EMR/Ahlstrom Test	12,500	3,026	–	9,474
– British Columbia Research Council	99,570	80,108	–	19,462
	$ 4,194,413	$ 2,693,422	$ 239,311	$ 1,261,680

TABLE 1 CONT'D.

Project	Funds Committed	Prior Years' Disbursements	Disbursements April 1/83 to March 31/84	Balance
Bitumen Upgrading Fwd.	$ 4,194,413	$ 2,693,422	$ 239,311	$ 1,261,680
Petrochemicals – Mitsubishi	679,500	679,640	953	(1,093)
Eureka Process	433,755	433,755	–	–
California Synfuels	414,760	12,757	223,378	178,625
REM Feasibility Study	125,000	125,000	–	–
McKinsey & Associates Study	75,000	75,000	–	–
Porta Plants Inc.	10,000	3,632	4,465	1,903
Gulf Oil – Donor Process	540,000	–	390,000	150,000
Raylo Chemicals	115,446	–	111,046	4,400
Advanced Fuel Research	25,830	–	18,804	7,026
RTM/ARC Process	25,000	–	16,214	8,786
Battelle Laboratories	50,000	–	33,582	16,418
	$ 6,688,704	$ 4,023,206	$ 1,037,753	$ 1,627,745
Technology Handling				
Data Base Administration	$ 2,752,515	$ 1,319,135	$ 654,653	$ 778,727
Technical Reports	91,865	91,865	–	–
AOSTRA Journal	160,000	5,334	32,353	122,313
Patent Costs	500,000	242,970	110,307	146,723
	$ 3,504,380	$ 1,659,304	$ 797,313	$ 1,047,763
Training Activities	$ 1,305,000	$ 697,273	$ 328,732	$ 278,995
International Activities	$ 1,780,800	$ 653,879	$ 325,160	$ 801,761
Totals	$315,979,350	$200,013,712	$37,717,542	$78,248,096

TABLE 2

Statement of Revenue

Expenditure & Fund Balance

Oil Sands Technology and Research Fund
Nine-Year Summary
For the years ended March 31

	1984	1983	1982	1981	1980	1979 and Prior	Total
Revenue							
Alberta Heritage Savings Trust Fund	$54,500,000	$39,500,000	$28,500,000	$28,000,000	$38,000,000	$62,949,032	$251,449,032
Technology sales	1,988,107	2,876,477	3,477,561	2,362,893	282,312	422,650	11,410,000
	$56,488,107	$42,376,477	$31,977,561	$30,362,893	$38,282,312	$63,371,682	$262,859,032
Expenditures							
Institutional Research							
Alberta Research Council							
- Information Centre	$ 495,183	$ 438,174	$ 394,205	$ 313,017	$ 200,000	$ 800,000	$ 2,640,579
- Oil Sands Research Centre	3,236,077	2,877,172	2,369,308	2,508,783	1,336,003	5,017,827	17,345,170
- Sample Bank	134,761	261,881	240,975	218,361	65,763	81,064	1,002,805
- Geological Program	642,157	521,195	469,740	353,953	67,842	-	2,054,887
Inventors Assistance Grant	130,000	-	-	-	-	-	130,000
University Contracts	3,152,248	3,478,549	2,103,367	1,975,243	1,291,193	2,246,849	14,247,449
Professorships	461,515	546,121	472,084	353,813	167,730	362,500	2,363,763
Post Doctoral Fellowships	1,040	-	-	-	-	-	1,040
Scholarships and Fellowships	383,807	184,823	201,760	85,131	121,541	293,966	1,271,028
Hatch & Associates	246,258	-	-	-	-	-	246,258
Ontario Research Foundation	-	-	1,622	4,477	-	-	6,099
British Columbia Cancer Foundation	63,514	43,126	-	-	-	-	106,640
ARC - Access Program	4,244	-	-	-	-	-	4,244
University Access Program	35,918	26,771	44,159	26,882	-	-	133,730
Program Planning and Evaluation	192,924	-	-	-	-	-	192,924
Petroleum Recovery Institute	514,315	-	-	-	-	-	514,315
Syncrude Canada Ltd.	581,730	-	-	-	-	-	581,730
	$10,275,691	$ 8,377,812	$ 6,297,220	$ 5,839,660	$ 3,250,072	$ 8,802,206	$ 42,842,661
Mining and Extraction							
Retorting							
- Umatac	$ 2,800,255	$ 1,532,063	$ 1,348,402	$ 812,790	$ 653,734	$ 1,631,689	$ 8,778,933
- Lurgi	38,579	(114,724)	-	239,075	319,870	62,220	545,020
Tailings Treatment							
- Xana	332,585	692,663	617,160	333,242	223,455	185,641	2,384,746
- EcoPlastics	-	-	-	16,829	16,598	26,490	59,917
Dredging	(43)	174,844	-	-	16,760	10,898	202,459
Solvent Study	-	-	-	-	26,343	-	26,343
Oil Sands Demonstration Centre	218,782	(33,106)	18,253	23,069	-	-	226,998
Kruyer Research	-	100,000	240,000	-	-	-	340,000
Suncor/Kruyer Project	60,000	-	-	-	-	-	60,000
R.T.R. Project	-	-	100,000	-	-	-	100,000
Nova/Husky/Canstar	65,889	-	-	-	-	-	65,889
Inpro Engineering	5,338	-	-	-	-	-	5,338
	$ 3,521,385	$ 2,351,740	$ 2,323,815	$ 1,425,005	$ 1,256,760	$ 1,916,938	$ 12,795,643
In Situ Oil Sands							
Peace River							
- Shell	$ 3,037,950	$ 3,416,430	$ 7,413,067	$ 6,510,798	$22,074,583	$20,752,198	$ 63,205,026
Athabasca							
- Amoco	(66,986)	234,416	1,865,234	4,241,687	3,086,470	15,378,323	24,739,144
- Numac/Gulf	(285)	286	(36)	(20,846)	129,684	1,340,662	1,449,465
- Hudson's Bay	-	-	-	3,199	33,372	272	36,843
- Canterra Energy Ltd.	46,384	6,190,000	-	-	-	-	6,236,384
- Petro-Canada/Esso	3,500,000	-	-	-	-	-	3,500,000
- Texaco Canada	41,570	-	-	-	-	-	41,570
	$ 6,558,633	$ 9,841,132	$ 9,278,265	$10,734,838	$25,324,109	$37,471,455	$ 99,208,432

TABLE 2 CONT'D.

	1984	1983	1982	1981	1980	1979 and Prior	Total
In Situ Oil Sands Fwd.	$ 6,558,633	$ 9,841,132	$ 9,278,265	$10,734,838	$25,324,109	$37,471,455	$ 99,208,432
Wabasca							
– General American	37,211	1,284,680	–	–	–	–	1,321,891
Cold Lake							
– B.P.	878,117	2,429,899	3,231,266	991,585	948,474	7,355,891	15,835,232
– Colt Engineering	40,330	–	–	–	–	–	40,330
– Suncor – Ft. Kent	14,641	–	–	–	–	–	14,641
Gemini	–	37,339	123,544	99,487	–	–	260,370
Walden	–	–	9,346	87,268	–	–	96,614
Francis Hankin	379,905	25,695	–	–	–	–	405,600
Monenco	–	3,000	35,000	–	–	–	38,000
Mineralogical Study	1,001	–	–	–	–	–	1,001
Waterloo Centre	189,046	118,314	111,333	–	–	–	418,693
Electrical Heating Study	96,323	31,149	6,294	–	–	–	133,766
Water Treatment Study	133,767	(4,283)	3,137	–	–	–	132,621
Consultants	–	–	–	–	6,630	23,970	30,600
	$ 8,328,974	$13,766,925	$12,798,185	$11,913,178	$26,279,213	$44,851,316	$117,937,791
Underground Access							
Athabasca							
– Tunnelling	$ –	$ –	$ –	$ –	$ 17,970	$ 159,420	$ 177,390
– Gulf Surmont Project	21,192	(20,803)	1,461,788	3,101,732	366,965	–	4,930,874
– U.T.F. Project	3,376,745	1,289,690	–	–	–	–	4,666,435
	$ 3,397,937	$ 1,268,887	$ 1,461,788	$ 3,101,732	$ 384,935	$ 159,420	$ 9,774,699
Carbonate Trend							
Buffalo Creek							
– Union Oil	$ 2,950,100	$ 6,385,525	$ 4,812,576	$ 2,111,852	$ 1,993,570	$ 3,299,595	$ 21,553,218
Heavy Oil							
Petro-Canada	$ 993,554	$ 2,105,364	$ 1,577,690	$ 1,135,972	$ 4,834,786	$ 1,256,030	$ 11,903,396
A.E.C.	224,545	311,857	1,617,001	2,747,632	58,696	–	4,959,731
Pengalta	25,934	36,808	102,475	417	17,570	–	183,204
	$ 1,244,033	$ 2,454,029	$ 3,297,166	$ 3,884,021	$ 4,911,052	$ 1,256,030	$ 17,046,331
Enhanced Recovery Conventional Oil							
Vikor Resources Ltd.	$ 4,666,445	$ –	$ –	$ –	$ –	$ –	$ 4,666,445
P.R.I.	553,804	(66,805)	304,915	20,669	14,888	–	827,471
PanCanadian Petroleum	116,017	–	–	–	–	–	116,017
McCallum, Stewart & Associates	–	3,427	23,246	–	–	–	26,673
Husky Oil	33,445	121,938	–	–	–	–	155,383
Norcen	3,513	85,289	–	–	–	–	88,802
Cold Lake Heavy Oil	111,290	240,260	–	–	–	–	351,550
D.B. Robinson	17,325	–	–	–	–	–	17,325
Hycal Energy	8,625	–	–	–	–	–	8,625
	$ 5,510,464	$ 384,109	$ 328,161	$ 20,669	$ 14,888	$ –	$ 6,258,291
Bitumen Upgrading							
Flexicoking – Exxon	$ –	$ –	$ –	$ –	$ –	$ 353,829	$ 353,829
Hydrocracking – E.M.R.	–	–	–	–	–	214,520	214,520
Hydrotreating – UOP	–	–	–	–	88,785	87,398	176,183
– Catalytic Inc.	–	2,740	53,747	144,685	–	–	201,172
Residue Utilization Project	23,730	10,645	–	–	–	–	34,375
Heavy Oil Upgrading Demo Centre	13,061	–	–	–	–	–	13,061
Heavy Oil Upgrading Study	202,520	1,094,500	494,281	65,158	–	–	1,856,459
Fluid Bed Combustion							
– EMR/Ahlstrom Test	–	–	3,026	–	–	–	3,026
– British Columbia Research Council	–	80,108	–	–	–	–	80,108
Petrochemicals – Mitsubishi	953	3,787	2,853	2,877	265,855	404,268	680,593
Eureka Process	–	417,437	16,318	–	–	–	433,755
California Synfuels	223,378	–	12,757	–	–	–	236,135
REM Feasibility Study	–	38,586	86,414	–	–	–	125,000
McKinsey & Associates Study	–	42,000	33,000	–	–	–	75,000
	$ 463,642	$ 1,689,803	$ 702,396	$ 212,720	$ 354,640	$ 1,060,015	$ 4,483,216

TABLE 2 CONT'D.

	1984	1983	1982	1981	1980	1979 and Prior	Total
Bitumen Upgrading Fwd.	$ 463,642	$ 1,689,803	$ 702,396	$ 212,720	$ 354,640	$ 1,060,015	$ 4,483,216
Porta Plants Inc.	4,465	3,632	–	–	–	–	8,097
Gulf Oil – Donor Process	390,000	–	–	–	–	–	390,000
Raylo Chemicals	111,046	–	–	–	–	–	111,046
Advance Fuel Research	18,804	–	–	–	–	–	18,804
RTM/ARC Process	16,214	–	–	–	–	–	16,214
Battelle Laboratories	33,582	–	–	–	–	–	33,582
	$ 1,037,753	$ 1,693,435	$ 702,396	$ 212,720	$ 354,640	$ 1,060,015	$ 5,060,959
Technology Handling							
Data Base Administration	$ 654,653	$ 549,409	$ 333,810	$ 116,073	$ 198,691	$ 121,152	$ 1,973,788
Technical Reports	–	–	–	91,865	–	–	91,865
AOSTRA Journal	32,353	5,334	–	–	–	–	37,687
Patent Costs	110,307	45,886	52,277	66,184	78,623	–	353,277
	$ 797,313	$ 600,629	$ 386,087	$ 274,122	$ 277,314	$ 121,152	$ 2,456,617
Training Activities	$ 328,732	$ 289,725	$ 207,109	$ 200,439	$ –	$ –	$ 1,026,005
International Activities	$ 325,160	$ 232,466	$ 244,408	$ 177,005	$ –	$ –	$ 979,039
	$37,717,542	$37,805,282	$32,858,911	$29,160,403	$38,722,444	$61,466,672	$237,731,254
Excess of revenue over expenditures	$18,770,565	$ 4,571,195	$ (881,350)	$ 1,202,490	$ (440,132)	$ 1,905,010	$ 25,127,778
Fund balance at beginning of period	6,357,213	1,786,018	2,667,368	1,464,878	1,905,010	–	–
Fund balance at end of period	$25,127,778	$ 6,357,213	$ 1,786,018	$ 2,667,368	$ 1,464,878	$ 1,905,010	$ 25,127,778

AUDITOR'S REPORT AND FINANCIAL STATEMENTS

Alberta Oil Sands Technology and Research Authority

Oil Sands Technology and Research Fund

Financial Statements

March 31, 1984

Auditor's Report

Balance Sheet

Statement of Revenue, Expenditure and Fund Balance

Notes to the Financial Statements

LEGISLATIVE ASSEMBLY

ALBERTA

OFFICE OF THE PROVINCIAL AUDITOR

AUDITOR'S REPORT

To the Members of the Alberta Oil
Sands Technology and Research Authority

I have examined the balance sheet of the Alberta Oil Sands Technology and Research Authority – Oil Sands Technology and Research Fund as at March 31, 1984 and the statement of revenue, expenditure and fund balance for the year then ended. My examination was made in accordance with generally accepted auditing standards, and accordingly included such tests and other procedures as I considered necessary in the circumstances.

In my opinion, these financial statements present fairly the financial position of the Fund as at March 31, 1984 and the results of its operations for the year then ended in accordance with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

F.C.A.
Auditor General

Edmonton, Alberta
June 25, 1984

ALBERTA OIL SANDS TECHNOLOGY AND RESEARCH AUTHORITY
OIL SANDS TECHNOLOGY AND RESEARCH FUND

BALANCE SHEET

AS AT MARCH 31, 1984

	1984	1983
ASSETS		
Current:		
Cash	$27,092,505	$14,786,245
Deposits in trust (Note 3)	429,799	410,625
Deposits on projects, net (Note 4)	2,269,128	1,985,885
Accounts receivable	856,163	1,044,563
Prepaid expense	13,356	2,509
	$30,660,951	$18,229,827
LIABILITES		
Current:		
Accounts payable	$ 5,103,374	$11,342,146
Holdbacks payable	429,799	530,468
	5,533,173	11,872,614
Fund balance, Statement B	25,127,778	6,357,213
	$30,660,951	$18,229,827

The accompanying notes are part of these financial statements.

ALBERTA OIL SANDS TECHNOLOGY AND RESEARCH AUTHORITY
OIL SANDS TECHNOLOGY AND RESEARCH FUND

STATEMENT OF REVENUE, EXPENDITURE AND FUND BALANCE

FOR THE YEAR ENDED MARCH 31, 1984

	1984	1983
Revenue:		
Contributions by the Province of Alberta:		
Alberta Heritage Savings Trust Fund (Note 6)	$54,500,000	$39,500,000
Technology sales	1,988,107	2,876,477
	56,488,107	42,376,477
Expenditure:		
In situ oil sands, net	11,726,911	15,035,812
Institutional research	10,275,691	8,377,812
Enhanced recovery	5,510,464	384,109
Mining and extraction	3,521,385	2,351,740
Carbonate trend	2,950,101	6,385,525
Heavy oil, net	1,244,032	2,454,029
Bitumen upgrading	1,037,753	1,693,435
Technology handling	797,313	600,629
Training activities, net	328,732	289,725
International activities	325,160	232,466
	37,717,542	37,805,282
Excess of revenue over expenditure for the year	18,770,565	4,571,195
Fund balance at beginning of year	6,357,213	1,786,018
Fund balance at end of year	$25,127,778	$ 6,357,213

ALBERTA OIL SANDS TECHNOLOGY AND RESEARCH AUTHORITY
OIL SANDS TECHNOLOGY AND RESEARCH FUND

NOTES TO THE FINANCIAL STATEMENTS

MARCH 31, 1984

Note 1 Authority

The Alberta Oil Sands Technology and Research Authority operates under the authority of The Oil Sands Technology and Research Authority Act, Chapter 0-6, Revised Statutes of Alberta 1980.

Note 2 Significant Accounting Policies

The statements present Fund transactions only, therefore, those costs charged to the General Revenue Fund are not shown on the balance sheet or on the statement of revenue, expenditure and fund balance but are disclosed in Note 7.

Expenditures from the Fund are not capitalized due to the intangible nature of assets that may accrue to the Authority. The Authority will be entitled to share in any assets remaining at the end of a project in proportion to its percentage of participation.

A statement of changes in financial position is not provided as disclosure in these financial statements is considered to be adequate.

Note 3 Deposits in Trust

Deposits in trust consist of deposits in the General Trust Fund of the Province of Alberta.

Note 4 Deposits on Projects

The amount of $2,269,128 (1983 $1,985,885) shown on the balance sheet represents the net excess of cash calls on projects over actual expenditures.

Note 5 Advances from the Province of Alberta

The Oil Sands Technology and Research Authority Act provides for advances from the General Revenue Fund of the Province of Alberta not to exceed $100,000,000.

Note 6 Contributions by the Province of Alberta

The Appropriation (Alberta Heritage Savings Trust Fund, Capital Projects Division) Act, 1983 provided for payments to the Authority to a maximum of $68,000,000 for the year ended March 31, 1984 (1983 $74,000,000). Amounts actually received from this source totalled $54,500,000 (1983 $39,500,000) The provision which enables the Authority to receive funds up to the stated maximum lapses at the end of the fiscal year.

Note 7 Administration Costs

Administration Costs of the Authority, provided for by Section 13 of the Act, are paid by the Province from funds appropriated for that purpose and are summarized as follows:

	1984	1983
Salaries and wages	$1,396,980	$1,353,124
Fees and commissions	764,443	734,583
Rental of property and equipment	243,265	480,984
Employee benefits	180,210	194,629
Travelling and hospitality	178,395	189,438
Furniture and equipment purchases	52,980	39,059
Materials and supplies	49,335	44,138
Staff relocation costs	17,028	5,748
Equipment maintenance	16,452	13,224
Advertising	9,472	9,182
Telephone and telegraph	7,507	12,089
Freight, express and postage	4,159	19,956
Grants	724	3,214
Contracts for construction	–	200
	$2,920,950	$3,099,568

Note 8 Commitments

In addition to the total expenditure shown on Statement B, the Authority had outstanding commitments as at March 31, 1984 totalling $78,248,096 (1983 $57,114,741) for approved projects.

Note 9 Approval of Financial Statements

These financial statements were approved by management on June 25, 1984.